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CHICAGO

ATROPHIC RHINITIS

TREATMENT WITH ESTROGENIC SUBSTANCES, WITH BIOPSY
BEFORE AND AFTER TREATMENT

WATT W EAGLE, M D

ROGER D BAKER, M D

AND

E C HAMBLEN, M D

DURHAM, N C

Mackenzie¹ in 1884 presented the first scientific evidence of the existence of a nasogenital relation. At this time and subsequently, in 1898,² he reviewed in a classical manner the allusions of the amatory and erotic literature and folklore of the past to such a functional association. A brief digest of some of these earlier beliefs, which possess striking historical interest, is presented.

In the Ayur-Veda, the sacred medical classic of the ancient Hindus, indulgence in venery headed the list of causes of nasal catarrh. The term "bride's cold" suggests this point of view. The size and shape of the nose in man were regarded by the early physiognomists as an index of the size of the genitalia. Noses of adulterers were amputated. In astrology Venus was supposed to govern the nose and to preside over generation. Kaspar Baitholin related that Duns Scotus pretended to be able to diagnose virginity by touching the cartilage of the nose.

Mackenzie cited many reports indicative of the existence of "the well-known sympathy between the erectile portions of the generative tract and other erectile structures of the body." Nosebleed, stoppage of the nostrils and sneezing during sexual excitement were related to the ecstasies of amorous contact and to the consummation of the sexual act. Amatus Lusitanus described a patient who sneezed at the sight of a beautiful woman. Thomas Baitholin and others mentioned patients who sneezed during intercourse. Sneezing has been described as one

From the Departments of Otolaryngology, Pathology and Endocrinology, Duke University Hospital and Medical School.

1 Mackenzie, J. N. Irritation of the Sexual Apparatus as an Etiologic Factor in the Production of Nasal Disease, *Am J M Sc* 87 360, 1884.

2 Mackenzie, J. N. The Physiological and Pathological Relations Between the Nose and the Sexual Apparatus of Man, *Bull Johns Hopkins Hosp* 9 10, 1898.

of the signs of pregnancy. The erotic effects of olfactory impressions have been known and employed for ages. As Mackenzie observed

Woman, in all ages, from the perfumed courtesan of ancient Babylon to her reflected image in the harem of the Sultan to-day, has appealed to the olfactory sense to bring man under her sexual dominion and to fire his passionate desire.

Mackenzie based his concept of the nasogenital relation on a number of clinical observations. He described the occurrence in healthy women, with no local nasal or gynecologic disease, of an "engorgement of the nasal cavernous tissue" with unvarying regularity during the menstrual epoch, the swelling of the membrane subsiding with the cessation of the catamenial flow.³ He described an "engorgement of the turbinated bodies" which took place at "the onset of the menstrual molimen, reached its acme during the full establishment of the process and disappeared with the subsidence of the ovarian excitement." He called attention to the fact that nasal disorders not infrequently are aggravated during the menstrual epoch. Some nasal disturbances were found to occur only at the time of menstruation. In some instances the nasal discharge may be less during the menstrual flow. It is interesting to note, in reference to the present concepts of atrophic rhinitis, that he observed that in "most cases of ozoena, the foetor is much more pronounced, at times corresponding to that of the uterine flow."

These studies of Mackenzie were followed closely by those of Arviset,⁴ Isch-Wall,⁵ and Joal.⁶ Subsequently there appeared the works of Peyer,⁷ and Eindriss.⁸ Fliess's⁹ elaborate monograph did not appear until 1897. Of all these studies, the last has been the most frequently quoted and is the best known. Fliess described *Genitalstellen*, small spots of sensitive erectile tissue located at the anterior end of the lower turbinate and in the tuberculum of the septum. These spots correspond well with those described by Mackenzie⁹ fourteen years before. Fliess advised local treatment of these spots with cocaine in

3 Arviset, L. Contribution a l'etude du tissu erectile des fosses nasales, Thesis, Lyon, no. 383, 1887.

4 Isch-Wall, cited by Mackenzie.²

5 Joal. De l'epistaxis genitale, Rev mens de laryng 9 74 and 129, 1888.

6 Peyer, A. Ueber nervosen Schnupfen und Speichelfluss und den pathologischen Zusammenhang derselben mit Erkrankungen des Sexualapparates, Munchen med Wchnschr 36 38 and 60, 1889.

7 Eindriss. Ueber die bisherigen Beobachtungen von physiologischen und pathologischen Beziehungen der oberen Luftwege zu den Sexualorganen, Inaug Dissert., Wurzburg, 1892.

8 Fliess. Die Beziehungen zwischen Nase und weiblichen Geschlechtsorganen in ihrer biologischen Bedeutung dargestellt, Vienna, Franz Deuticke, 1897.

9 Mackenzie, J. N. On Nasal Cough and the Existence of a Sensitive Reflex Area in the Nose, Am J M Sc 86 106, 1883.

cases of dysmenorrhea, since they were found to be sensitive and turgid at the time of menstruation

Recent experimental data bear testimony to the close association of the nasal and the genital system. Karpow¹⁰ reported in 1929 that bilateral turbinectomy in young rabbits resulted in failure of testicular descent and retarded development of the sexual organs. Nemours¹¹ confirmed Karpow's observations. Jung and Chavanne¹² and Pighini and Porta¹³ described modifications in the nasal mucosa following gonadectomy. Rosen and Shelesnyak¹⁴ reported in 1937 that painting or irrigating the nasal mucosa of female rats with a normal estrous cycle produced prolonged diestral phases, as judged by vaginal smears. The ovaries of these animals contained corpora lutea, and traumatization of the uterus resulted in the formation of deciduomas. Extension of these studies to include the effects of other local agents on the nasal mucosa has been described recently.¹⁵ The following observations were reported. Stimulation with oil of mustard apparently affected the regularity of estrous cycles by altering the follicular phase. Local applications of tannic and of trichloroacetic acid produced in a number of animals a prolongation of the diestral phase. Anesthetization with nupercaine resulted in the production of pseudopregnancy in a large percentage of cases.

From Montreal, Canada, the city where, coincidentally, in 1897 Mackenzie addressed the British Medical Association on "The Physiological and Pathological Relations Between the Nose and the Sexual Apparatus of Man," there have come, during the past three years, a number of important studies by Mortimer and Collip and their group¹⁶ on the endocrine biology of the nasal mucosa, the endocrine

10 Karpow, N. Zur Frage des Zusammenhangs der Nase mit der Sexualsphaere, *Monatschr f Ohrenh* **63** 758, 1929

11 Nemours, P. R. Effect of Experimental Bilateral Turbinectomy on the Development of the Testes in the Rabbit, *Arch Otolaryng* **22** 626 (Nov) 1935

12 Jung, L., and Chavanne, F. La secretion nasale après castration, *Otorhino-laryng internat* **18** 481, 1934

13 Pighini, G., and Porta, C. F. L'azione reintegrativa degli estratti antepofisari ed ovarici sulle alterazioni sperimentali della mucosa ed ossa nasali de castrazione, *Valsalva* **10** 140, 1934

14 Rosen, S., and Shelesnyak, M. C. Induction of Pseudopregnancy in the Rat by Silver Nitrate on Nasal Mucosa, *Proc Soc Exper Biol & Med* **36** 832, 1937

15 Shelesnyak, M. C., and Rosen, S. Naso-Genital Relationship. Induction of Pseudo-Pregnancy in Rat by Nasal Treatment, *Endocrinology* **23** 58, 1938

16 (a) Bachman, C., Collip, J. B., and Selye, H. Effect of Prolonged Oestriol Administration upon the Sex Skin of *Macaca Mulatta*, *Proc Roy Soc, London, sB* **117** 16, 1935, (b) Further Studies of Sex Skin Reactions in the *Macaca Mulatta*, *Proc Soc Exper Biol & Med* **33** 549, 1936 (c) Mortimer, H., Wright, R. P., Bachman, C., and Collip, J. B. Effect of Oestrogenic Hormone Administration upon Nasal Mucous Membrane of the Monkey (*Macaca Mulatta*),

associations of atrophic rhinitis and constitutional deafness and the clinical value of intranasal applications of crystalline estrogens for these two diseases, particularly for atrophic rhinitis. The endocrine role in the nasogenital relation was established as follows. This group of workers was able to identify characteristic alterations in the nasal mucosa of healthy monkeys during the menstrual cycle and during pregnancy. These were similar, as regards the time of occurrence and intensity, to those seen in the nipples and "sexual skin." The nasal changes were most clearly seen in the middle and inferior turbinates, which showed reddening and swelling or swelling alone. Similar alterations were produced in sexually immature or castrated adult monkeys by hypodermic injections of esthion (theelin) and estradiol and by oral administration of estriol (theelol) and estriol glucuronide. Examination of the nasal mucosa of women during the latter half of pregnancy showed progressive swelling and redness of these tissues. Studies of cranial roentgenograms related a cranial dysplasia thought to be indicative of pituitary disease to the occurrence of atrophic rhinitis and constitutional deafness in many patients. Local application of crystalline estrone or estradiol in corn or sesame oil to the nasal mucosa of male or female patients resulted in gratifying clinical responses. As a rule, 1 cc of oil solution containing 1,000 international units of crystalline estrogen was applied locally daily for approximately thirty days. In a number of instances constitutional deafness, occurring as a single symptom or in association with atrophic rhinitis, responded to similar therapy.

The value of intranasal application of crystalline estrogens in the treatment of atrophic rhinitis was confirmed by Blaisdell.¹⁷ He presented a few photomicrographs of the mucosa taken during the course of therapy. These were inconclusive. The studies of Hamilton¹⁸ indicated that the effect on the nasal mucosa is not specific for estrogens but may be produced also by androgens. He observed alterations in the nasal mucosa of monkeys and of 8 human beings after the use of testosterone propionate.

ibid **34** 535, 1936 (d) Mortimer, H., Wright, R. P., and Collip, J. B. The Effect of Oestrogenic Hormones on the Nasal Mucosa. Their Role in the Naso-Sexual Relationship, Their Significance in Clinical Rhinology, *Canad. M. A. J.* **35** 615, 1936, (e) Atrophic Rhinitis. The Constitutional Factor, and the Treatment with Oestrogenic Hormones, ibid **37** 445, 1937 (f) Mortimer, H., Levene, G., and Rowe, A. W. Cranial Dysplasias of Pituitary Origin, *Radiology* **29** 279, 1937 (g) Mortimer, H., Wright, R. P., Thomson, D. L., and Collip, J. B. Intra-Nasal Administration of Oestrogenic Hormones in Constitutional Deafness, *Canad. M. A. J.* **40** 17, 1939.

17 Blaisdell, I. H. The Use of Estrogenic Substances in Atrophic Rhinitis, *Laryngoscope* **48** 699, 1938.

18 Hamilton, J. B. Changes in the Nasal Mucosa of Monkeys (*Macaca Rhesus*) and Humans by Male Hormone Substances, *Proc. Soc. Exper. Biol. & Med.* **37** 366, 1937.

SURVEY OF MATERIAL

Our study is concerned with a small group of patients (14) with atrophic rhinitis who were treated somewhat similarly to those of the Montreal, Canada, group and sections of whose nasal mucosa before and during therapy were studied in regard to specific histologic alterations attributable to the local action of the estrogens¹⁹

The first biopsy specimen in each case was obtained previous to any treatment with estrogenic substances and the second was taken from twenty-seven to two hundred and sixteen days after, the first treatments with estrogenic substances having been started immediately after the first biopsy. Our period of observation was from April 1, 1938, to Jan 3, 1939. Some of the patients treated had been followed for from one month to seven years previously, all of these had been using nasal irrigations of 1:6000 dilution of potassium permanganate previous to this period of observation. Others were new patients. Several had had sinistral and nasal operations. No patient complained specifically of deafness and tinnitus, and therefore we are unable to make any report on the response of these conditions to this method of treatment. Each patient had a negative Wassermann reaction of the blood. Four were male and 10 female. Two were Negroes, both of these being male. The average age was 33, and the duration of the disease varied from one to forty years, but in each instance the disease apparently started in early youth. Two patients were in the midst of the menopause, 1 having a rather stormy course with multiple neuroses.

Twenty-two patients started the estrogenic treatment and had the original biopsy, but owing to economic reasons and distance, 8 did not return for the second biopsy. The average duration of treatment between biopsies was eighty-four days, but leaving out 2 cases of treatment for two hundred and sixteen and one hundred and fifty-nine days brings the average down to sixty-three days.

Our method of treatment differed from the Montreal method in that we had the patients irrigate the nose twice daily with physiologic solution of sodium chloride or 1:10,000 solution of potassium permanganate and ten minutes later repeat the irrigation to remove the crusts that had been loosened by the earlier washing. Then 0.5 cc of estrogenic substance was sprayed into the nose twice daily, to give each patient the equivalent of 1 cc, or 1,000 international units, per day. The atomizer used for such treatment was of the type used by asthmatic patients in obtaining a fine spray of epinephrine hydrochloride intranasally.

Twenty-one of the 22 patients reported clinical benefit, and each wished to continue treatment. The patient with stormy menopausal symptoms stated that she was not improved to the slightest degree. Our inspection of the nose revealed certain marked diminution or complete eradication of crusts in all 14 cases in which the study was completed and in no instance was there detectable the odor characteristic of the disease. The only changes noticeable in the mucosa were a slight increase in hyperemia and a more smooth surface. Patients complaining of a burning sensation in the scalp and occipital headache were relieved of those symptoms. We are unable to state whether the patients' noses were free of crusts because of the more frequent irrigations or because of the estrogenic therapy.

A brief résumé of each case is supplied (table 1).

19 Two estrogens were employed: amniotin (containing estrone) in corn oil and progynon DH (estradiol) in sesame oil. These were used in a concentration of 1,000 international units per cubic centimeter. Amniotin was supplied by E. R. Squibb & Sons, New York; progynon DH was supplied by the Schering Corporation, Bloomfield, N. J.

HISTOLOGIC CHANGES

What changes might one expect to occur in the structure of the nasal mucosa as the result of the therapy?

Mortimer, Wright and Collip,^{16c} who treated a large group of patients with estrogenic substance, stated

In time the mucosa presents a more normal appearance, it loses its pale greyish, oedematous character, and comes to have a pink, glistening colour

TABLE 1—Data on Cases

Case No	Patient	Race	Sex	Age	Dates of Biopsies	Total Amount of Estrogenic Substance, Cc	Duration of Condition, yr	Complications
1	F C	Negro	M	33	6/ 7/38 7/15/38	40	1	
2	E C	White	F	47	4/28/38 5/30/38 10/20/38	70	20	Menopausal symptoms, much silver therapy of nose, sinus infections and operations
3	J F	White	M	54	11/22/38 12/19/38	30	10	
4	F B	White	F	56	11/ 2/38 12/ 2/38	40	20-40	Sinusitis
5	L M	White	F	36	8/26/38 9/24/38	30	16	
6	I C	White	F	43	4/25/38 6/ 6/38	30	35	
7	R P	White	F	65	4/26/38 12/20/38	90	3	
8	A S	White	F	24	4/23/38 7/11/38	50	20	Sinus infection, acetanilid poisoning, bromidism
9	P P	White	M	54	7/12/38 12/21/38	50	20	Sinus infection operations
10	A B	White	F	35	10/31/38 12/20/38	60	30	Stormy menopause (artificial)
11	C M	Negro	M	34	10/31/38 12/20/38	60	3	
12	A T	White	F	27	4/ 7/38 6/ 9/38	50	25	
13	J G	White	F	17	10/ 7/38 12/28/38	30	1	
14	D B	White	F	32	10/18/38 1/ 3/39	30	21	

On the basis of the experimental work on the monkey, already referred to, it is reasonable to suppose that this treatment induces a hyperaemia, an increased glandular activity in the mucosa, and, perhaps, in time, an actual increase or hyperplasia of the mucosal glands. While the clinical appearances would seem to justify such a thought, it is to be clearly understood that so far we can offer no histological evidence of this from biopsy material.

Hamilton¹⁸ studied the effect of androgenic substances on the nasal mucosa. He found that testosterone propionate effected changes in specialized nasal areas in both male and female monkeys. In monkeys and in human beings congestion, swelling and formation of fluid were

observed grossly. Histologically perivascular edema was pronounced in the monkeys. The nasal areas affected were similar to those which exhibit vicarious menstruation.

Certain vacuolar changes called mucification occur in the vaginal epithelium of rodents in the prepubertal state and during pregnancy and the period of activity of the corpus luteum. Similar changes can be produced in spayed rodents by the use of estrogenic substances or of a combination of estrone and progesterone. Moreover, cornification can be produced if large doses of some of these substances are given.²⁰ Might similar changes take place in the nasal mucosa?

It might be ventured that a ciliated type of epithelium would replace stratified epithelium concurrently with the improvement in the clinical course of the patient. Ciliated epithelium would provide a more rapid movement of secretions.

In the study of the biopsy specimens, therefore, special attention was directed to the character of the surface epithelium, the size and nature of the glandular system, the vascularity of the tissue and the perivascular edema.

The biopsy specimens for the present study were obtained from the anterior tip of the middle turbinate. An idea of the usual structure of this region was obtained from several "control" patients in the course of operations for correction of septal deflections and the like. A good description of this has been given by Heiss²¹ and need not be repeated here.

Oppikofer²² in 1906 reported on the microscopic examination of the nasal mucosa at 200 routine autopsies. Complete longitudinal sections of the middle and the inferior turbinate bone were studied. Several of his observations are pertinent to the present study.

Instead of these bones being covered exclusively with pseudostratified columnar ciliated epithelium, squamous epithelium was observed in 126 of the 200 cases and an intermediate or "transitional" type of epithelium in 39 cases, leaving only 35 cases in which only the columnar type of covering epithelium occurred. If squamous epithelium was present on

20 Robson, J. M., and Wiesner, B. P. Causation of Mucification and Cornification in the Vagina of the Mouse, *Quart. J. Exper. Physiol.* **21**: 217, 1931. Mayer, R. K., and Allen, W. M. Production of Mucified Cells in the Vaginal Epithelium of Certain Rodents by Oestrin and by Corpus Luteum Extracts, *Anat. Rec.* **56**: 321, 1933. Selye, H., Browne, J. S. L., and Collip, J. B. Effect of Combined Administration of Oestrone and Progesterone in the Adult Ovariectomized Rats, *Proc. Soc. Exper. Biol. & Med.* **34**: 198, 1936.

21 Heiss, R. Der Atmungsapparat, in von Mollendorff, W. *Handbuch der mikroskopischen Anatomie des Menschen*, Berlin, Julius Springer, 1936, vol. 5, pt. 3, p. 720.

22 Oppikofer, E. Beiträge zur normalen und pathologischen Anatomie der Nase und ihrer Nebenhöhlen, *Arch. f. Laryng. u. Rhin.* **19**: 28, 1906.

a turbinate bone it lay in the great majority of cases at the anterior tip and extended backward. Hornification occurred occasionally. Squamous epithelium was found in a 7 day old boy. It occurred at all ages and was not proportional to age. The 2 cadavers with the greatest amount of squamous epithelium appeared normal on clinical examination. Those in which ozena had been present during life showed squamous epithelium, but some showed less than many of the normal controls. Intraepithelial glands, budlike formations of goblet cells, were noted in 164 of the 200, more frequently at the posterior ends of the turbinates. The true subepithelial glandular system was lacking in only 1, but was poorly developed in many instances. As a rule, the glands were fairly evenly distributed along the extent of the middle turbinate.

OUR HISTOLOGIC OBSERVATIONS

Protocols of our biopsies before and after treatment in 14 cases were prepared, complete objective descriptions being given. Unfortunately, biopsy specimens taken before and after treatment were not available in the remaining 8 cases, but when only a single specimen was available, it did not differ materially from those described in the more completely studied cases. A low power binocular microscope was employed in addition to the compound microscope to obtain an idea of the general topography, richness of vessels and looseness of tissue. A specimen protocol follows.

E. C. (CASE 2)

E. C. (case 2) Before Treatment—The epithelium was squamous in places. No ciliated epithelium was seen. Mucous glands were conspicuous, although serous glands occurred. The plasma cell infiltration among the glands was moderate. The fibrous tissue was compact, and fibrosis was present, apparently, in some areas. The vessels were prominent but not conspicuous. (Figure shows a small portion of the specimen.)

After Treatment—The epithelium was squamous in places. Sometimes the surface cells of the multilayered epithelium were vacuolated. The glands had about the same proportion of serous cells as at the previous biopsy. The cellular infiltration was considerable. The lymphocytes tended to form nodules. Fibrous tissue and vessels were moderate in amount (fig. 2). Comment: No definite differences were noted.

The comments on the "before treatment" and "during treatment" biopsies in the 14 cases in which two specimens were available for comparison were as follows:

Case 1 No definite differences were noted.

Case 2 No definite differences were noted.

Case 3 No definite differences were noted.

Case 4 The specimen after treatment was much more glandular and edematous. Many of the glands were serous, with prominent eosin-staining granules.

Case 5 No differences were noted.

Case 6 More mucous seemed to occur in the glands after treatment.

Case 7 General cellular infiltration was more marked after than before treatment.

Case 8 The epithelium of the excretory ducts showed more mucous, perhaps, after treatment.

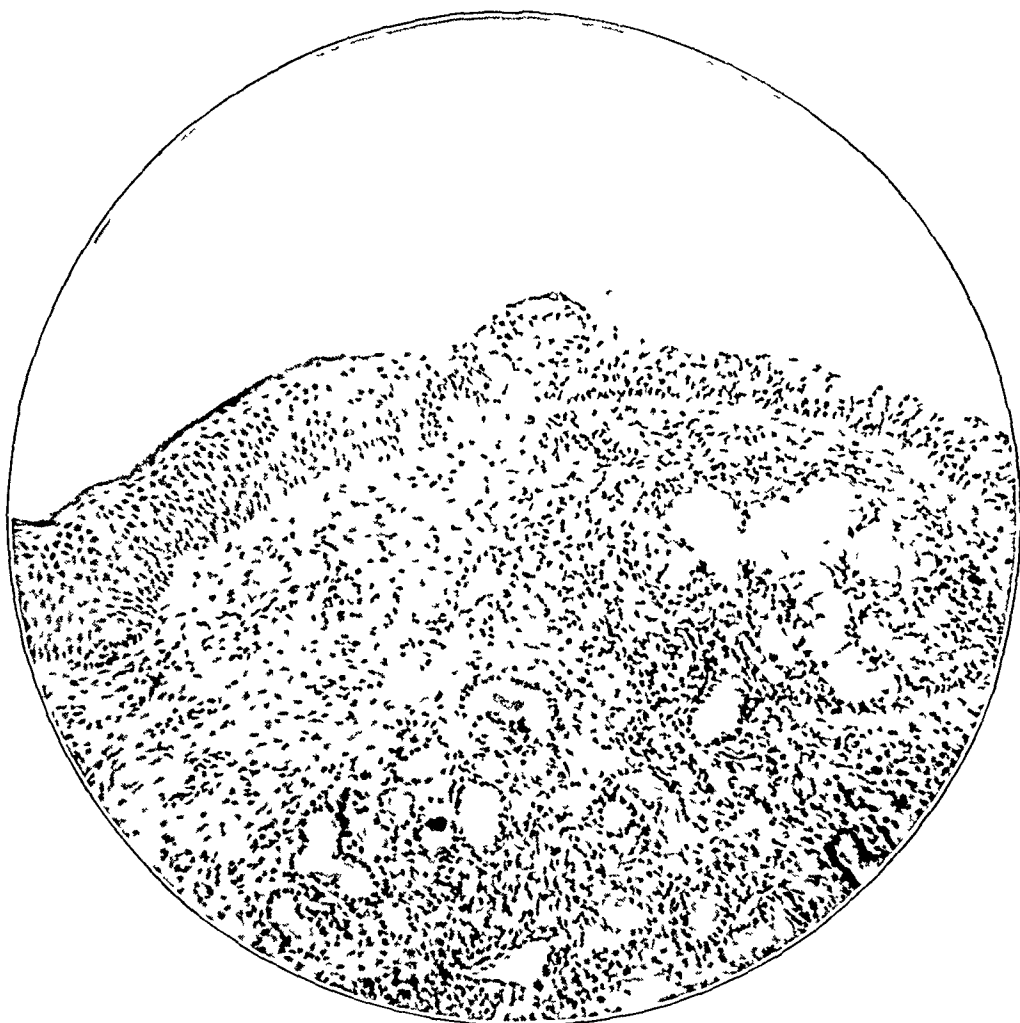


Fig 1 (case 2) —Specimen removed before treatment. Stratified squamous epithelium occurs on the left and "transitional" epithelium on the right. The subepithelial glands are partly serous and partly mucous in this particular field.

Case 9 The inflammatory reaction was more intense after treatment. Cilia were noted in excretory ducts to about the same extent before and after treatment.

Case 10 The glands contained more mucous cells after treatment. So did the "bays" on the surface epithelium.

Case 11 No differences were noted. Ciliated surface epithelium occurred rarely in the specimens.

Case 12 No differences were noted.

Case 13 The surface epithelium showed more mucous cells and subepithelial tissue and more cellular infiltration after than before treatment

Case 14 The surface epithelium showed more vacuolated cells after treatment, but the difference was not great enough to justify speaking of mucification Cellular infiltration was severe after treatment and minimal before treatment

The impression was gained, therefore, that the surface epithelium and the subepithelial glandular system contained more mucous cells

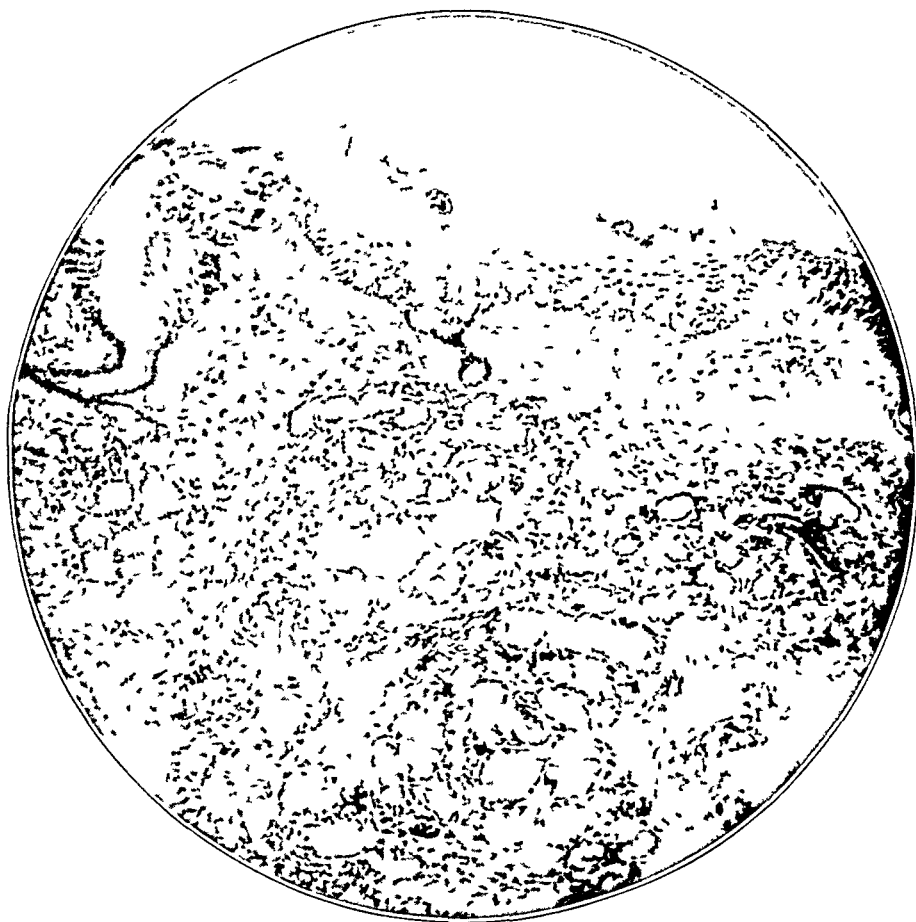


Fig 2 (case 2)—Specimen removed after treatment The epithelium is “transitional” The glands have about the same proportion of mucous and serous cells as before The cellular infiltration is the same Vascular spaces show well in this field

after treatment than before It appeared that the amounts of squamous and ciliated epithelium and the vascularity, as well as various other features, were not altered

Photomicrographs of portions of the specimens removed before and after treatment (figs 1 to 8) serve mainly to show the variety of histologic appearances obtainable, and to explain the headings in table

2 Several different appearances were often present in a single section. It is apparent, however, that no perfectly consistent change in any one direction existed. Mucous cells in the glands were present before and after treatment, squamous epithelium predominated before treatment in some instances and after treatment in others, the general appearance of fibrosis or increased density of the tunica propria occurred sometimes after treatment (figs 3 and 4) and sometimes before treatment (figs 7 and 8).

TABLE 2—*Comparison of Biopsy Specimens*

	Before Treatment	After Treatment
Surface epithelium		
Stratified, total extent, all cases	66%	59%
Transitional	24%	22%
Columnar	10%	19%
	<hr/> 100%	<hr/> 100%
Predominantly squamous (with keratinization)	11 cases	7 cases
Predominantly columnar	3 cases	2 cases
Cilia noted	0 cases	2 cases
Intraepithelial glands	2 cases	2 cases
	3 cases	4 cases
Glands (subepithelial)		
Present in	13 cases	12 cases
Ratio of glandular volume	12	1
Predominantly mucous	4 cases	3 cases
Connective tissue		
Cellular infiltration		
3 plus	1 case	3 cases
2 plus	5 cases	5 cases
1 plus	8 cases	6 cases
Fibrosis		
3 plus	1 case	
2 plus	3 cases	
1 plus	10 cases	13 cases
0 (poly p like)		1 case
Vascular system		
Prominent	12 cases	13 cases
Not prominent	2 cases	1 case
Perivascular edema present	6 cases	5 cases

A second method was employed in the study of the biopsy specimens. This consisted of mixing up all of them and analyzing them without knowledge of the patient or of whether the specimen was taken before or after treatment. Table 2 is a summary of the results of this objective type of analysis. Examination of the table shows no startling differences in the specimens before and after treatment. The amount of columnar epithelium present, both in total extent on the combined surfaces and in predominance in individual cases, was slightly greater after treatment. However, the amount of glandular tissue was about the same before and after treatment and the proportion of mucous to serous cells was not changed. The intraepithelial glands were not significantly more numerous after treatment. Thus, the general impression obtained by the protocol method was not obtained by the statistical method.

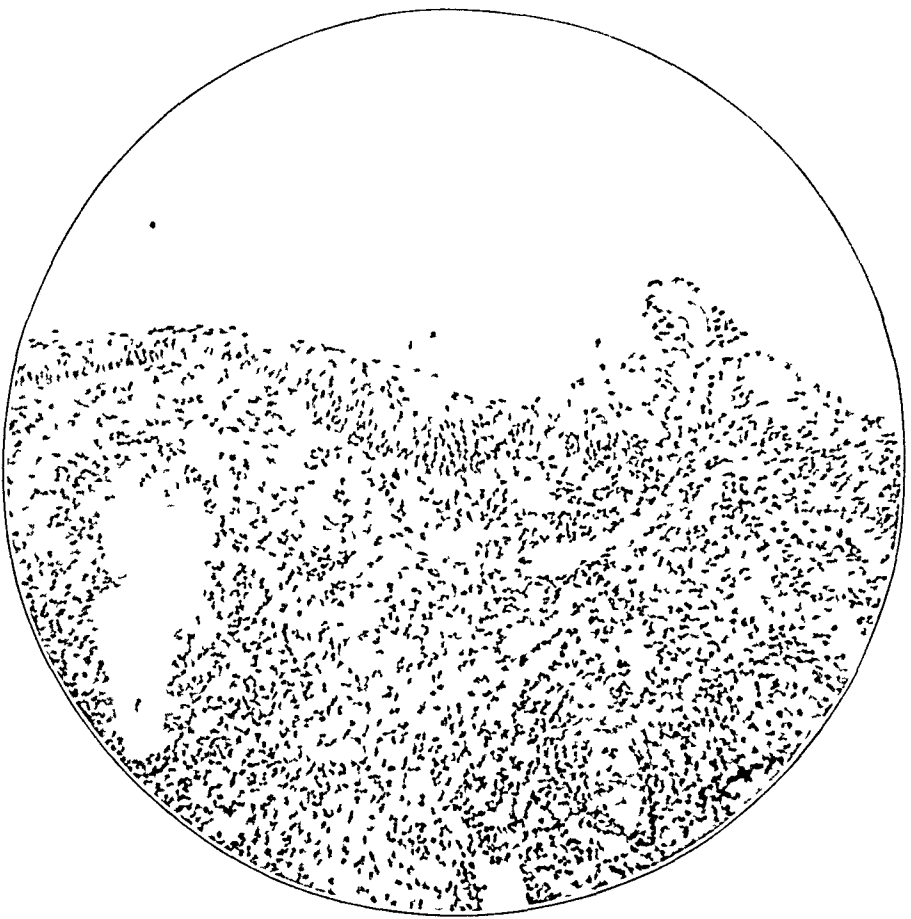


Fig 3 (case 9) —Specimen removed before treatment The epithelium is partly squamous and partly "transitional" A large excretory duct is shown on the left, but the cilia do not appear

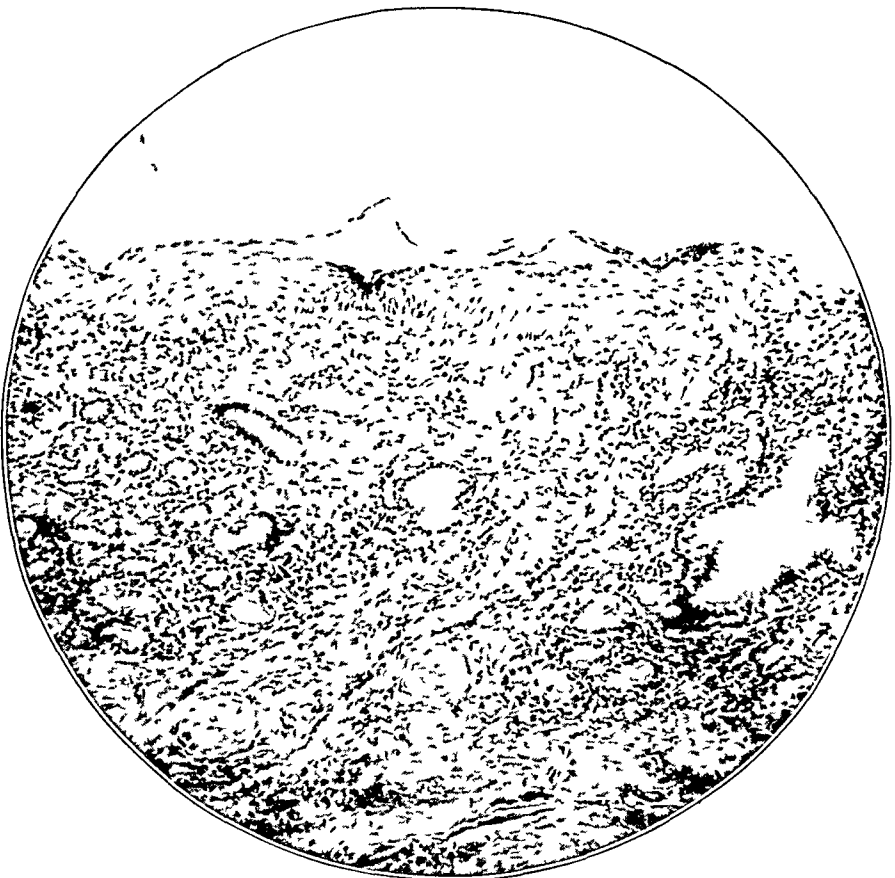


Fig 4 (case 9) —Specimen removed after treatment This field shows stratified and keratinized epithelium, glands and rather intense cellular infiltration

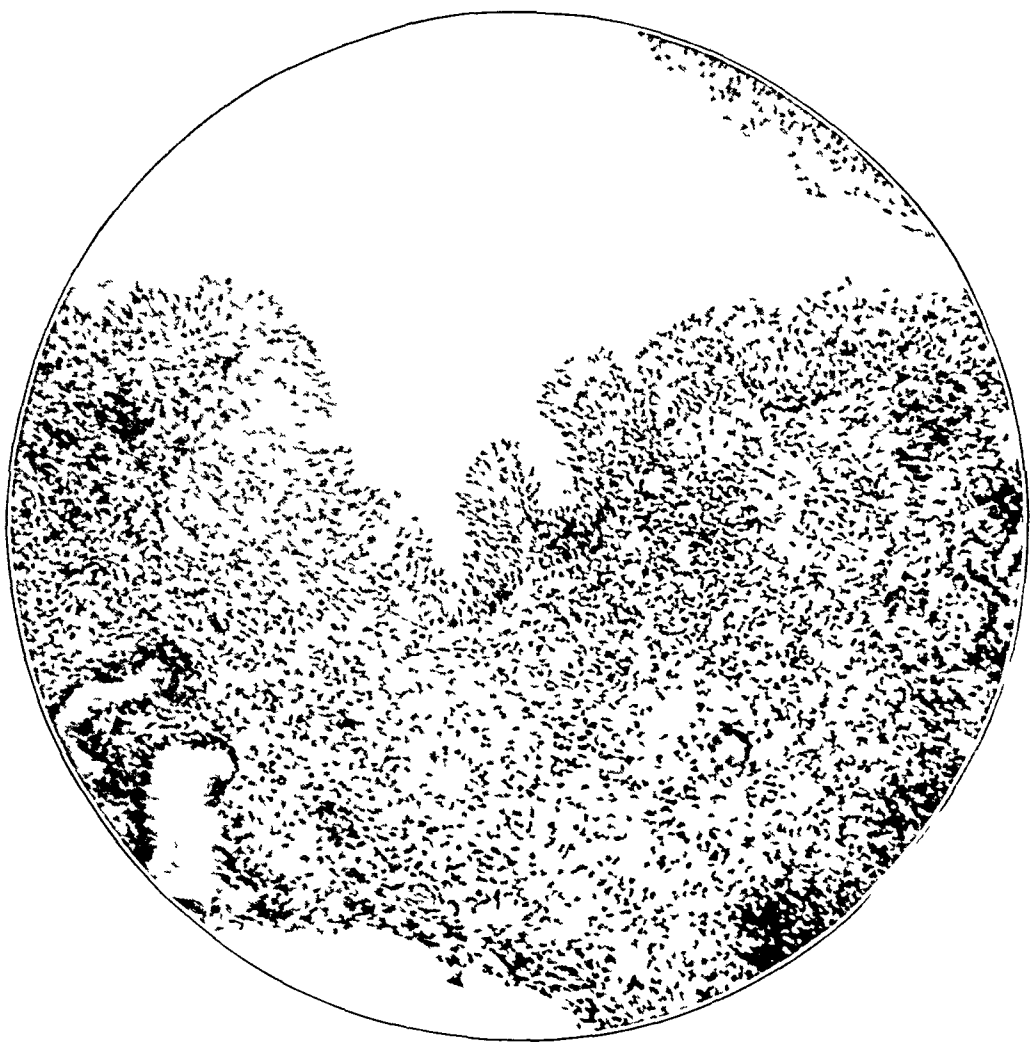


Fig 5 (case 11) —Specimen removed before treatment, showing ciliated pseudostratified columnar epithelium The cilia are not clearly seen at this magnification

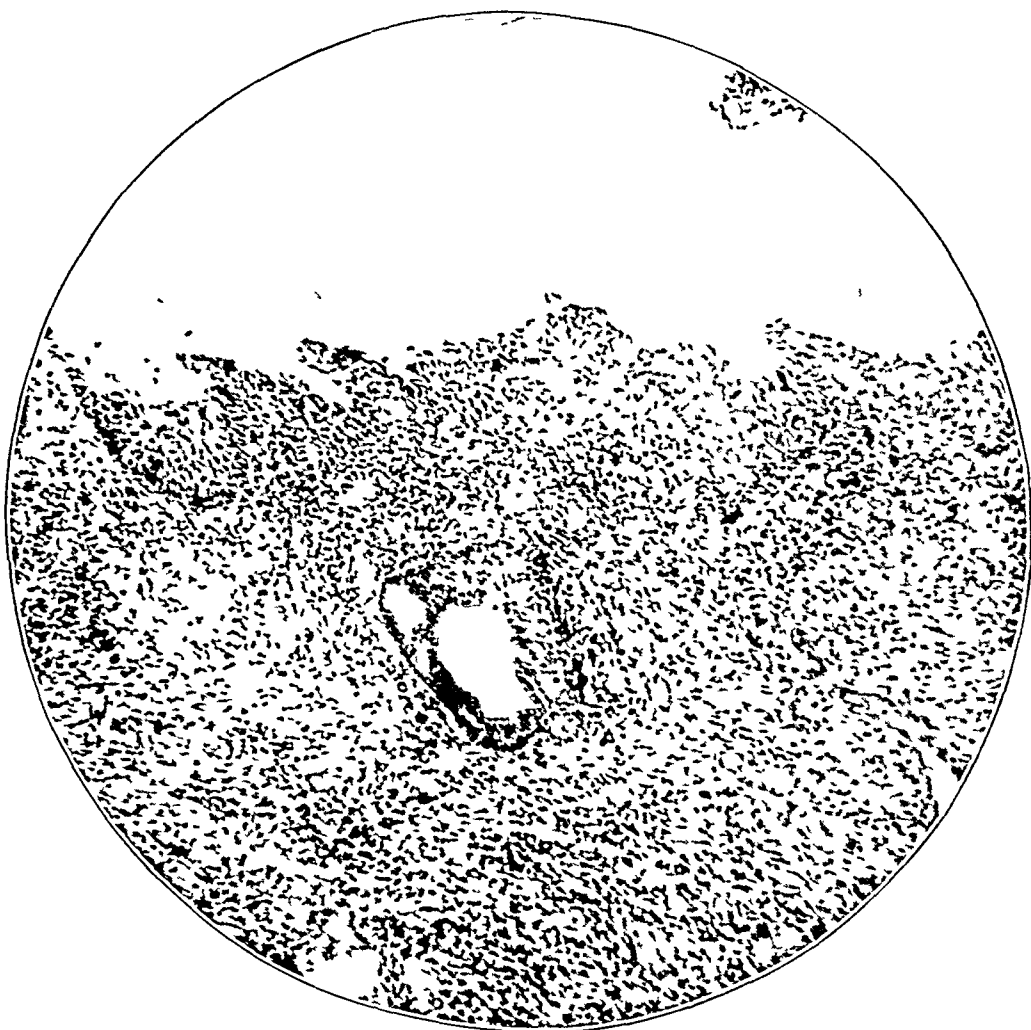


Fig 6 (case 11) —Specimen removed after treatment, showing transitional epithelium



Fig 7 (case 13) —Specimen removed before treatment The covering epithelium is of the stratified squamous type, the subepithelial glands, mainly serous Dense fibrous tissue is present in the tunica propria

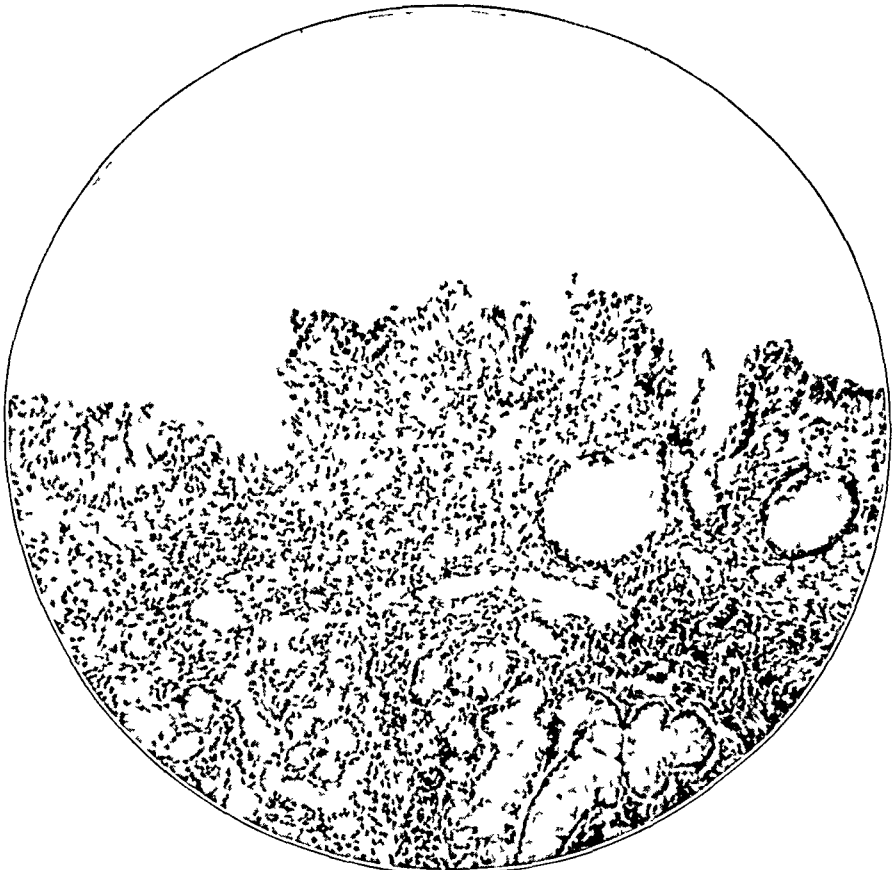


Fig 8 (case 13) —Specimen removed after treatment Intraepithelial glands of the surface epithelium can be seen to the left The subepithelial glandular system shows many mucous cells

It is to be noted, however, that fibrosis was recorded more frequently before than after treatment. Although this fact does not arrest the attention in the data catalogued by the protocol method, it is possible that the tunica propria is looser, i. e., does contain more fluid, after treatment than before. An attempt to evaluate the prominence of the vessels and of the perivascular edema showed no significant differences before and after treatment. Evaluation of these features as well as of fibrosis is exceedingly difficult. Moreover, the states of vascularity, looseness and fluid content of specimens are subject to many factors, such as the condition of the nasal mucosa when the specimen was taken and the squeezing of the tissue in obtaining it. Statements regarding congestion and edema of excised tissues must be made with caution, unless the findings are obvious at a glance.

COMMENT

It seems clear that no striking changes in the histologic picture in these 14 cases were effected by the treatment. No widespread mucification, cornification or other alteration of the surface epithelium occurred. The subepithelial system was unaltered, and it is questionable that the tissues became more congested or edematous. The protocol method of analysis merely suggested increased function of the mucous glands, and the statistical method merely suggested decreased density of the tunica propria after treatment. It is possible that study of a far larger series of patients might give significance to some of these suggestions. The present observations indicate the absence of obvious morphologic changes.

SUMMARY

Twenty-one of 22 patients treated with estrogenic substances for atrophic rhinitis were clinically improved, both subjectively and objectively, and desired to continue the treatment. In 14 cases biopsy specimens were obtained from the diseased middle turbinate before and during (or after) treatment.

Study of the biopsy specimens taken before and during (or after) treatment failed to reveal obvious changes or definite changes in a single direction. Suggestive alterations included (1) minimal increase in the mucous character of the glands and (2) increased looseness (edema?) of the connective tissue. The amounts of squamous and ciliated epithelium and the vascularity, as well as other features, were not altered.

NASOGRAPH MIRROR OF GLATZEL AS A MEASURE OF NASAL PATENCY

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Despite numerous studies of the dynamics of nasal patency, there is no satisfactory method for the quantitative determination of the diameter of the nasal passages. The ingenious method of Steinheim and Schui (1936) measures manometrically the resistance offered to a stream of air during its passage through the nose. It has the advantage of giving a quantitative value of resistance as a measure of the patency of each nostril separately. The method, however, lacks simplicity and depends for its success on the cooperation of the patient. At first thought, it would seem an advantage to measure each nasal passage individually. It will be shown that such measurements taken without reservation do not express the physiologic status of one nostril in respect to the other. As one passage is contracted, the other will carry more than its share of air, but not in direct proportion to the obstruction. The amount of air that may be inspired through one nostril when the other is closed is but a slight indication of the amount that will be expired through it when the other nostril is fully open. Other conditions being constant, a partially obstructed nostril will allow the passage of more or less air according to the patency of its mate.

The Glatzel (1904) mirror as modified by Cocks (1915) was designed primarily to indicate the obstruction of the nasal passages by means of the moisture deposited on a cold metal mirror. The size, shape and position of the deposit on the mirror give a rough index of the patency of the two nasal passages tested simultaneously. The method has the advantages of simplicity and of independence of the cooperation of the patient. The moisture deposits are delineated on the metal plate by means of a crayon and then transferred to a ruled paper for a permanent record.

Our contribution is to modify the Glatzel mirror method so that the results are of quantitative value. The essential difference between the two is that in the original application of the method no cognizance was

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taken of the time required for evaporation of the deposited moisture. Detailed study has shown this determination to be at least as valuable as the original one as a measure of nasal patency. The two together yield information of sufficient importance to warrant serious consideration. In figure 5, 7 and 7*a* show how the evaporation time indicates nasal patency not made obvious by the size of the moisture deposit alone. This phenomenon is shown also by 10 and 13 in figure 4. In 10 the left nostril deposits a spot 14.1 sq. cm. in area while the evaporation time is 78 per cent of the total. In 13 the right nostril has been dilated by means of benzedrine and presumably the left nostril is of the same patency as in 10 yet the area on the left side has diminished to 2.7 sq. cm. and the evaporation time to 20 per cent of the total.

DESCRIPTION OF APPARATUS

No attempt will be made to differentiate between the original instrument of Glatzel and this one, because the details that have been added are of minor importance and full credit for the clever invention and its application should go to Glatzel. The main difference lies in the use made of the mirror and in the interpretation of the results. The refinements that we describe herein were made necessary because the investigation was of the nature of research. They are not necessary for clinical work, in which fractional changes are insignificant. In the planning of the apparatus it was necessary to take into account the following factors: (1) the temperature of the mirror, (2) the number of breaths and the total volume of air expired on the mirror as well as the time taken to expire it, (3) the temperature and humidity of the air in the room, (4) the recording of the spots of moisture directly they are deposited, (5) the measuring of the time of disappearance of the deposit from each nostril, and (6) the nasomirror distance.

The apparatus,¹ shown in figure 1, consists of a mirror of polished stainless steel (*M*), which has been cut out on one of its long edges to fit the convexity of the upper lip. At the circumference of the labial cut is fitted a bow-shaped strip of metal 1 cm. high (*N*), which is notched to receive the nasal septum and to assist the operator in centering the apparatus. The nasal strip (*N*) is removable for sterilizing. Its main object is the maintenance from reading to reading of a constant nasomirror distance of 1 cm. The surface of the mirror is transected by two lines at right angles. From the intersection of these two lines, distances of 1 cm. are marked off to serve as lines of reference. In order that the mirror's temperature shall change as little as possible during the procedure a chamber (*Q*) of copper is soldered under the mirror 1 cm. deep and about 1 cm. smaller than the mirror. Through suitable apertures (*T* and *T'*) the chamber is filled with water, while through another is put a small thermometer (*E*). The large volume of water (130 cc.) maintains the temperature of the mirror constant to within 0.2 C. for the maximum period of five minutes consumed by the test. When not in use the mirror is kept in a bath with a constant temperature of 25 C., accurate to 0.5 C. Ample time is given the mirror to regain the proper temperature, and readings may be made frequently by using alternately two mirrors such as that described.

¹ Made by Joseph Becker, New York.

The mirror is attached to a holder, primarily to insure for each patient quick and consistent application of the mirror to the lip in the same plane to the nasal orifices and also to insure minimal handling of the mirror by the warm hands of the operator. The holder (*H*) carries the mirror in a slot and can be fixed by means of a winged screw (*C*). Passing through a hole near the top of the holder rod is the support (*B*) of the brow piece (*D*). By sliding *B* nearer to or farther away from the holder rod while simultaneously moving the mirror (*M*) up or down the apparatus is fitted to the patient, and the relation is maintained throughout each experiment. By recording the positions of *B* and *C* it is possible to reproduce the relative position of the mirror in subsequent tests. The mirror

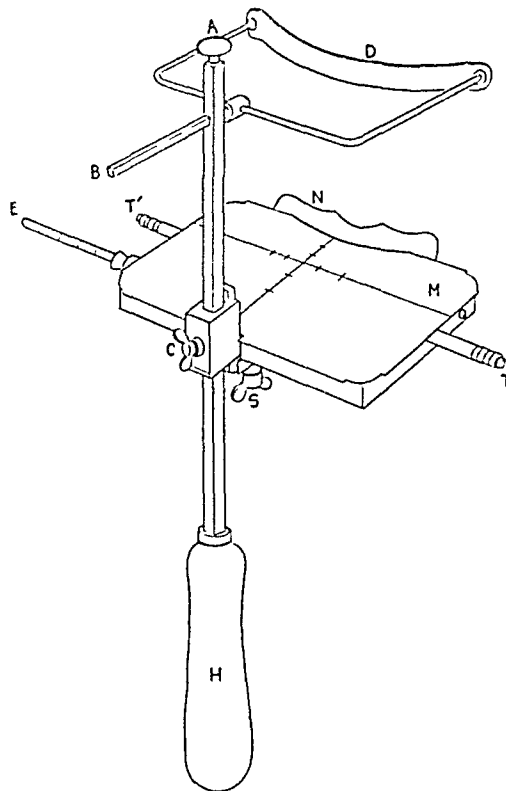


Fig 1 —The nasograph mirror and holder, described in the text

is removed from the slot by loosening the winged screw (*S*). Figure 1 shows how the apparatus looks when ready for use.

The recording apparatus consists of a wooden frame into which fits the mirror with its moisture-marked surface exactly in the focal plane of the camera lens (fig 2). For purposes of economy and ease of handling of the records, a 16 mm cinematic camera is used, adjusted for a single exposure. Strong illumination insures satisfactory photographic contrast. As soon as the exposure is made, the strong light is extinguished, so that the heat will not warm the plate. By means of a signal marker, the moment of the exposure is recorded on the sooted paper of a kymograph. As each of the moisture spots disappears, a mark is made on the moving paper. Figure 3 shows a typical nasograph record.

PROCEDURE

The subject sits quietly in a comfortable chair for at least fifteen minutes, so that breathing may reach a restful level. Meanwhile, the surface of the mirror is cleaned with alcohol followed by ether, to eliminate all traces of grease. The mirror frame is then adjusted to the patient, and the mirrors, after having been marked with the name of the subject, the date, the number of the experiment and the serial number of the observation, are put into the constant temperature bath. A red crayon or skin-marking pencil, serves admirably. When all is in readiness, the mirror is removed from the bath, dried and lightly polished with a napkin, the nasal strip is removed from its bath of 95 per cent alcohol, dried and put in place. The patient is urged to pay no attention whatever to the proceedings. The kymograph is started, and at the end of the next expiration the mirror is quickly

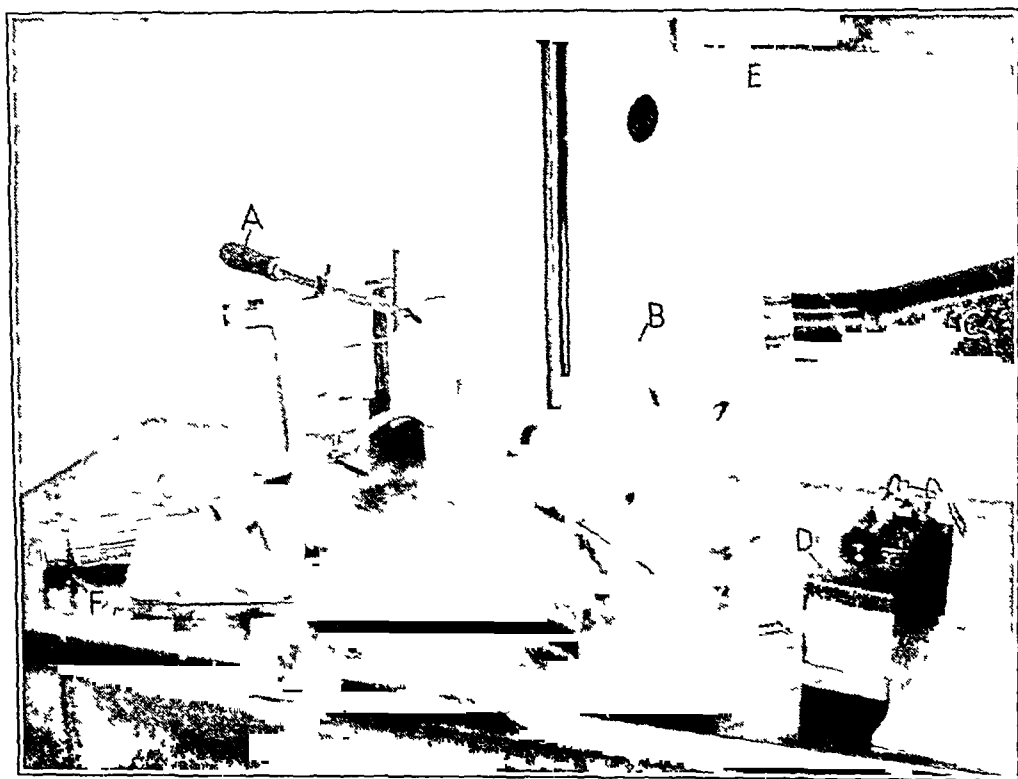


Fig 2—Arrangement for photographing the moisture deposits. *A*, nasograph mirror and holder, *B*, cinematic camera, *C*, source of light, *D*, signal marker key, *E*, kymograph, *F*, second nasograph mirror

adjusted to the nose. At the end of five expirations, the mirror frame is immediately dropped into the photographing slot, an exposure made and the fact recorded on the kymograph paper. The time elapsed between the starting of the drum and the first mark is a rough indication of the time for five breaths. The next signal marks the disappearance of one of the moisture deposits and is indicated with the letter "R" for right or "L" for left, as the case may be. The total time of disappearance of both spots is obtained by adding the times indicated by "R" and "L," while the percentage of each is its time divided by this sum.

The mirror just used is removed from the holder, the nasal tip is wiped and returned to the alcohol, the serial number is changed on the face of the mirror, and the latter is returned to the water bath. Another record may be taken by

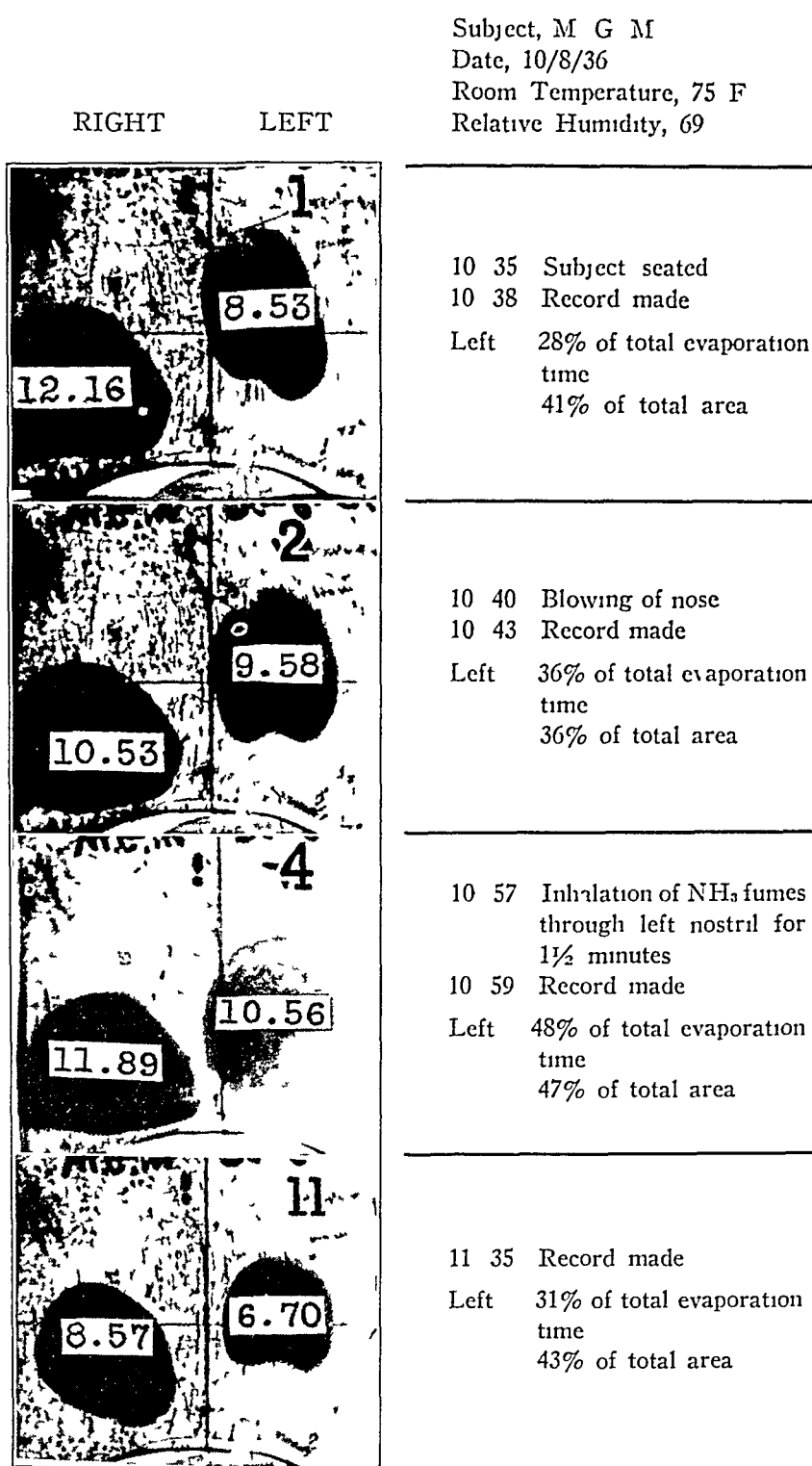


Fig 3—Photographs of moisture deposits (nasograms), about one-third the original size. The dark shadows indicate the deposited moisture. The numbers in them indicate the area in square centimeters. Only a few of the records are shown, for lack of space. (Details are given in the text)

the use of the second mirror with but little loss of time between observations. The procedure never exceeds five minutes, even on humid days. With the average male subject, at a temperature of 22 to 24 C and a relative humidity of 40 to 60, the average time for a "run" is less than three minutes, so that records may be made every three minutes if necessary. During any one period of experimentation, the temperature and humidity of the room, of which notations are frequently made, change insignificantly, so that successive records are comparable. The greatest single source of error is differences in the depth of breath, or the total amount of air expired in the five breaths, which changes the total time of evaporation of the deposits but leaves the relation of the right to the left nostril unaltered.

In figure 3, 4 shows a greater deposit of water than 2 because between 3 (not shown) and 4 the subject inhaled some dilute ammonia vapor through one nostril. The irritant vapor had forced him to breathe cautiously, resulting in momentary hyperpnea. The total air expired in the five breaths of 4 was greater than in those of 2.

RESULTS

All results are reported by means of the following figures: (1) the number of seconds necessary for the complete disappearance of each of the moisture spots from the mirror, (2) the sum of the disappearance time for the left (L) and that for the right (R), (3) the percentile value in terms of the left nostril, and (4) the area of the moisture spots determined from the photographs and measured by means of a planimeter. The shape and position of the spots are mentioned only when they are remarkable or when the experimental procedure has changed them.

In figure 3 is shown the type of graph obtainable from a normal subject under the conditions described. Successive determinations over periods of from one-half to two hours show that the percentile difference between the two nostrils remains approximately constant. The total evaporation time, however, diminishes with the passage of time, and represents a quieting of the breathing during the period of rest. In figure 3 is shown the effect of moderate exercise on this diminished volume. The experiment illustrated by 1 was made as soon as the subject entered the room, while 11 was taken one hour later. It is notable that the percentile values remain constant despite the changes in breathing volume, as indicated by the total evaporation time of $55 + 139$ seconds and $32 + 75$ seconds respectively. These results have been confirmed by 65 experiments on 40 subjects, most of them medical students. No experiments on patients are analyzed in the present report. There is appended to each experiment a short history of nasal symptoms as well as the subjective report as to which nostril felt the more patent when the opposite nostril was occluded with the finger. When the percentile difference in evaporation time was less than 10, the subject often had difficulty in deciding which nostril was the more patulous. However, when the difference exceeded 10 per cent, the figures based on the evaporation test and the subjective decision agreed in 100 per cent of the experiments.

Other conditions being equal, the shape and size of the moisture deposit indicate the shape and size of the nasal passage near the external meatus and bear little relation to the amount of air which is being expelled. Figure 3 shows two records in which the moisture deposits appear approximately of equal relative area in the two nostrils. In 1 the left is 41 per cent of the total area, and in 4 it is 47 per cent, yet the evaporation time indicates much greater obstruction in the left nostril in 1 (28 per cent) than in 4 (48 per cent). This difference in the values of the two measurements is of diagnostic import. In this case, the obstruction to the outflow of air through the relatively obstructed nostril must be far back, near the pharynx, a fact which was easily corroborated by direct examination of the nasal tissues. After the air has passed the obstruction, it has ample space in which to expand to the relatively normal size of the distal nasal passage. The size and shape of the left spot in 4 is therefore approximately normal (the area being within 10 per cent of that in 2). The relative amount of air that has passed the left nostril has increased from 36 to 48 per cent of the total, however, owing to the inhalation of smelling salts through it.

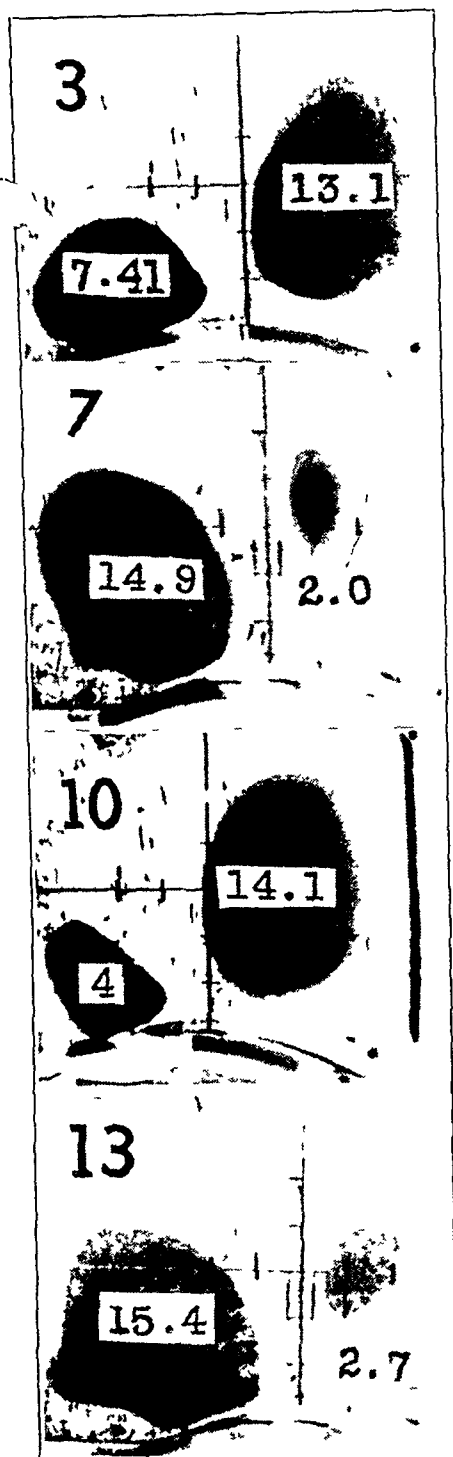
Determinations have been performed to show the effect on the nasal passage of three factors: (1) the position of the subject, (2) spraying with medicated nasal oils and (3) inhalation of a sympathomimetic drug in the form of a benzedrine inhaler.

1 *Effect of Position*—When the subject changes from the sitting to the supine position, with the nose pointing straight upward, there is no change in the relative amounts of the moisture deposited on the mirror from the two nostrils. The *total* amount of moisture is changed, however, because with the supine position breathing is more shallow and the total amount of air expired in five breaths is less than when the subject is sitting. On the other hand, when the subject lies on one side, with the face turned so that the plane of the nasal septum is parallel to the floor, partial to complete obstruction of the dependent side is usually produced. That this obstruction is not mechanical, due to polyps, mucus or redundant mucous membranes, is shown by the slowness of its development and by its diminution or abolishment by spraying with sympathomimetic drugs. Of 36 tests, obstruction was obtained in 30, or 83 per cent. Complete obstruction occurred 11 times. If, now, the relative position of the nostrils is reserved, the previously dependent side begins to open and the newly dependent side to close. The findings hold also for subjects who at the beginning of the experiment have partial obstruction on one side. When they lie down with the partially obstructed side down, the obstruction is increased. If the obstructed side is uppermost, it opens gradually, and the dependent side closes (fig. 4).

Subject, M G M
 Date, 10/22/36
 Room Temperature, 80 F
 Relative Humidity, 63

RIGHT

LEFT



3 58 Subject flat on back

4 18 Record made

Left 64% of total evaporation
 time
 64% of total area

4 19 Subject on left side

4 41 Record made

Left 14% of total evaporation
 time
 12% of total area

4 42 Subject on right side

4 57 Record made

Left 78% of total evaporation
 time
 77% of total area

5 01 Inhalation of benzedrine
 through capsule, 2 times
 into *right* nostril

5 08 Record made

Left 20% of total evaporation
 time
 14% of total area

Fig 4—Photographs of moisture deposits as in figure 3, showing the effects of change in position, as indicated by the appended table (Details are given in the text)

2 *Effect of Medicated Nasal Oils*—While the subject is in the sitting position, one nostril is sprayed with liquid petrolatum, plain or medicated with menthol, or with a "plain" medicated oil bought in the open market. During the spraying, which consists of five compressions of the atomizer bulb, the subject breathes through the mouth, while the opposite nostril is occluded either with a plug of cotton or with the finger to protect it from the medicament. At no time were we able to show objectively any change in the caliber of the sprayed nostril. The size or shape of the moisture deposit did not change, nor did the percentile time of evaporation as compared with that of the opposite and

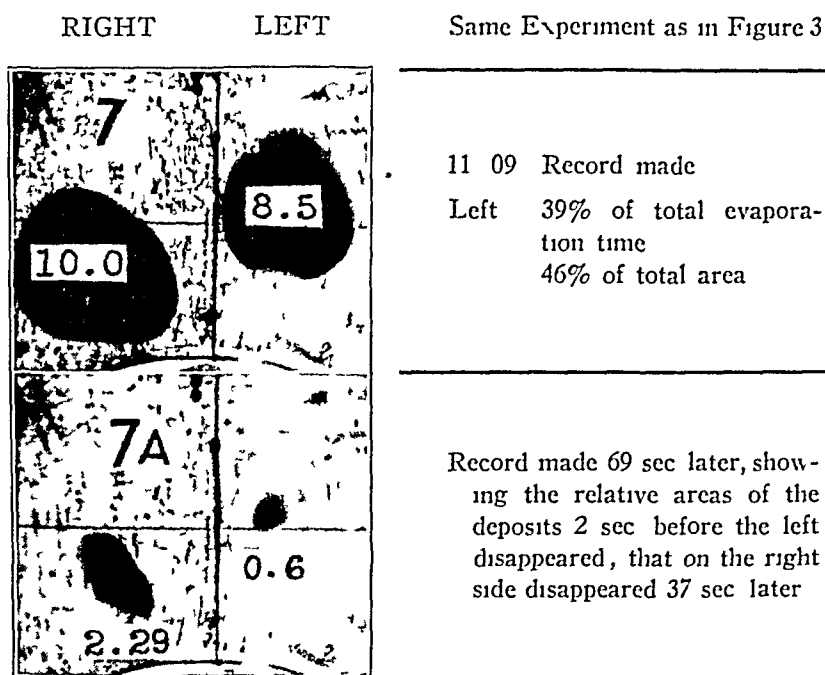


Fig 5—Same experiment as in figure 3, showing that the area of the deposited moisture is not so indicative of the amount of moisture deposited as is the evaporation time

untreated nostril. When the oil was medicated with menthol (1 per cent) or when a commercial spray was used, the subject invariably reported that the sprayed side now *felt* more open. In the absence of corroborative objective evidence to this effect, the subjective report is explainable on the basis of the cooling sensation imparted by the medicament, interpreted by the patient as an increase in the amount of air passing through the medicated nostril.

3 *Effect of the Benzidine Inhaler*—In order to test out the ability of the mirror method to measure changes in relative patency of the nostrils, the subjects inhaled through the less patent side two inspira-

tions through the capsule of a benzedrine inhaler² with precautions (as enumerated) to avoid medicating the opposite side. The results were diametric, especially when marked obstruction had been present. They are shown in figure 4. When the two nostrils are of about equal patency, the benzedrinized side is made more patulous. When the more open side is benzedrinized, it becomes further opened. When one nostril of a reclining subject has been obstructed by being made the more dependent (fig. 4), that nostril opens in response to the benzedrine and often becomes more patent than the uppermost. When a previously benzedrinized nostril is made posturally dependent, it fails to respond by obstruction to the change in posture. Further studies are in progress to test other sympathomimetic drugs. Since these have to be sprayed into the nostril in solution, it is necessary to check carefully the effectiveness of the solvent, as well as the effect of the active principle.

SUMMARY

An improved Glatzel mirror is described. With this instrument it is possible to measure quantitatively the amount of air passing through the nostrils during quiet breathing by observing the size, shape and position of the moisture deposit from expired air on a cold metal mirror and also noting the time of evaporation of such deposits.

By means of this instrument, called the nasograph, we have been able to show the following facts:

(a) Under basal conditions the percentile values for moisture deposits from the two nostrils remain constant unless disturbed by changes in position, drafts, medication or other factors.

(b) Change from the sitting to the supine position shortens the total time of evaporation of the deposits but leaves unaffected the percentile differences.

(c) A change in the reclining position, so that one nostril is more dependent than the other, caused the dependent nostril to become more constricted in 83 per cent of 36 subjects.

(d) Pure liquid petrolatum or "plain" medicated nasal oil does not influence the nasograph values recorded with the subject at rest, nor is it capable of opening the nose when some obstruction is present.

(e) Applied by inhalation, benzedrine opens still further a patent nostril, opens a nostril partially closed because of inflammation or posture (as stated under c) and prevents closure by posture.

² Benzedrine is a volatile sympathomimetic amine and was furnished gratuitously by Smith, Kline and French Laboratories.

MOTION PICTURES OF THE HUMAN LARYNX

WILLIAM A. LELL, M.D.

WITH THE ASSISTANCE OF WILLIAM J. SULLIVAN

PHILADELPHIA

Photography of the human larynx has for a long time absorbed the interest of physicians in general and of otolaryngologists in particular. This interest is justified by the accuracy and faithfulness with which an image of an object can be reproduced, the human error in evaluating one's observations by drawings or descriptions thus being eliminated.

Unfortunately, because of the anatomic location of the larynx, photography of this structure has encountered many difficulties. The outstanding problem in the past, for both still and motion picture photography, has been to find a means of proper illumination. A great deal of this difficulty has been overcome today by the remarkable improvement and refinement in the construction of cameras with "faster" lenses and the perfection of new, highly sensitized types of film. These remarkable advances in the field of photography have been a source of renewed interest among laryngologists in this sphere of endeavor, so that today it is nothing unusual to obtain both still and motion pictures of the human larynx, with faithful reproduction of the normal color.

It is remarkable that in spite of the lack of recent refinements early investigators were able to obtain fairly accurate photographs of the human larynx.

Lennox Browne¹ as far back as 1883 presented the first successful photographs of the human larynx before the British Medical Association.

The following year French² showed a large series of photographs of normal and abnormal larynges at the International Medical Congress at Copenhagen. The remarkable feature of this attempt at photography was the simplicity of the apparatus. He used a small, single

Read at the Second Post-Graduate and Alumni Medical Conference of the University of Rochester, Rochester, N. Y., April 9, 1938.

1 Browne, L. On Photography of the Larynx and Soft Palate, *Brit. M. J.* **2** 811, 1883.

2 French, T. R. On a Perfected Method of Photographing the Larynx. *New York M. J.* **40** 653, 1884, **65** 105, 1897.

lens camera, with a mirror attached, and the source of illumination was sunlight concentrated and reflected into the throat by a truncated cone. Later, he abandoned this form of illumination and substituted artificial light from an arc lamp.

The work of French was followed by quiescence of interest in laryngeal photography until 1919, when Garel³ reported his technic for securing stereoscopic pictures of the larynx.

In 1925 Clerf,⁴ using the Garel method and apparatus, showed a large series of interesting photographs.

As far as can be ascertained from a review of the literature, Heatly⁵ was the first to obtain motion pictures of the larynx. His method consisted of attaching the camera to the laryngoscope and photographing the larynx by direct laryngoscopic vision.

More recently, Pressman and Hinman,⁶ who also used this method, reported good results.

Lejeune, using a suspension apparatus, obtained beautiful pictures in color of a large variety of laryngeal lesions.

Dintenfass⁷ in 1934 showed motion pictures taken by mirror laryngoscopy in several cases.

In 1935 Tucker,⁸ who also used mirror laryngoscopy, presented his results before the British Medical Association.

Having seen this method in use, we felt that if properly standardized into an accurate routine procedure it could be of great value in developing renewed interest in laryngeal photography, particularly so because of its distinct advantages over the methods previously used.

Briefly, these advantages may be outlined as follows:

1 One achieves complete control and a wide range of illumination because of the source of light used.

2 The patient need not be subjected to direct laryngoscopic examination or the use of a suspension apparatus.

3 No anesthetic is needed except a 4 per cent solution of cocaine hydrochloride sprayed into the pharynx.

3 Garel, J. Nouvel appareil perfectionne pour la photographie stéréoscopique du larynx sur le vivant, *Rev. de laryng.* **40**:249, 1919.

4 Clerf, L. H. Photography of the Larynx, *Ann. Otol., Rhin. & Laryng.* **34**:101, 1925.

5 Heatly, C. A. Motion Picture Studies of the Larynx, *Ann. Otol., Rhin. & Laryng.* **40**:434, 1931.

6 Pressman, J. J., and Hinman, A. Simple Technic for Taking Motion Pictures of the Larynx in Action, *Arch. Otolaryng.* **26**:526 (Nov.) 1937.

7 Dintenfass, H. Personal communication to the authors.

8 Tucker, G. Inflammatory Tumors of the True Vocal Cords. Direct Laryngoscopic Observations, *J. Laryng. & Otol.* **51**:563, 1936.

4 The patient is completely cooperative, with the laryngeal structures relaxed, which would be practically impossible under direct laryngoscopic examination, and one can thus obtain a relatively more normal picture of the motility of the cords and surrounding structures of the larynx. Also by use of the mirror a wider field of observation is made possible, so that one can visualize not only the unrestrained movements of the cords but the epiglottis, the aryepiglottic folds and the surrounding structures of the pharynx.

5 The adaptability of this method makes it possible to set up the apparatus and take the necessary pictures in a few minutes.

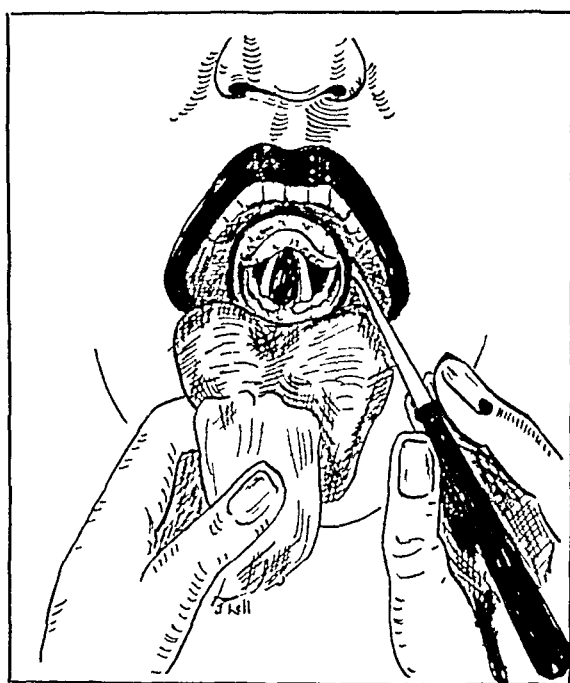


Fig 1—View of the larynx by mirror laryngoscopy

6 The image in the mirror can be accurately brought into focus and visualized at all times during the procedure by the person operating the camera.

There are two distinct disadvantages of the method at present.

- 1 It cannot be used for persons in whom it is difficult to visualize the larynx because of an overhanging epiglottis.

- 2 It is impracticable for small children or persons for whom a small mirror has to be used, as it is difficult to visualize and focus an image from a small mirror in the camera, although we have gotten good pictures of several children that were only 7 years of age.

For the past two years we have tried various schemes in order to work out a simplified method, and after many disappointments in our early trials we feel that the procedure at present is sufficiently practical for motion pictures of the larynx in natural color to be taken by any one with average skill in photography.

The basic factor involved in the method is simply a knowledge of the optical principle underlying mirror laryngoscopy, that the angle of reflection must be equal to the angle of incidence. This law is illustrated by the simple diagram in figure 1.

The laryngeal mirror must be placed in the patient's pharynx above and behind the larynx and at such an angle that light received on its surface is reflected downward into the larynx. The rays forming the laryngeal image will return along the same path and be reflected into

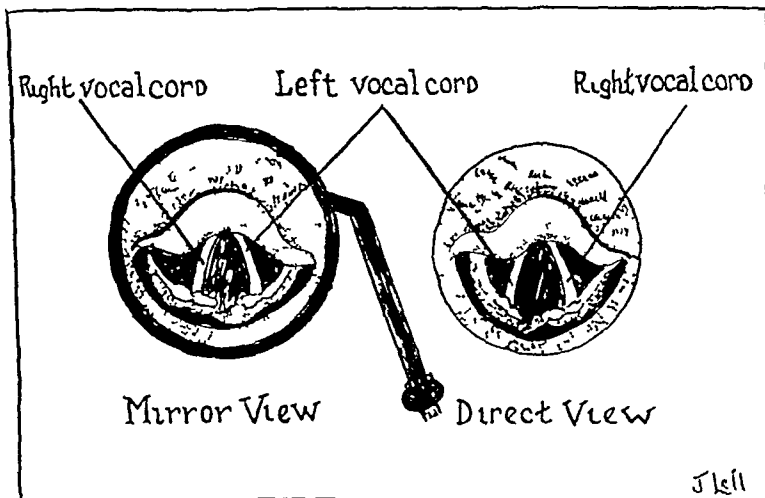


Fig 2—Contrast in the appearance of the larynx in mirror and direct laryngoscopy

the eye of the observer or into the lens of the camera when the latter is adjusted along this line.

Here one must bear in mind that the laryngeal image is a reflected one and that it is therefore reversed anteroposteriorly because the laryngeal mirror is above and behind the opening of the larynx. Also, since the observer is facing the patient, one must keep in mind that the observer's right side corresponds to the patient's left side (fig 2).

This is in direct contrast to the view obtained in direct laryngoscopic examination, in which the observer's right side corresponds to the patient's right side.

APPARATUS

A Cine kodak special 16 mm camera is equipped with a 2 inch (5 cm) anastigmat lens, f/19. Kodachrome type A film is used for color and SS panchromatic for plain photography. The source of illumination is (1) a flood light bulb with

a bull's eye reflector or (2) a 16 mm projector with a 500 to 750 watt lamp Special $1\frac{1}{4}$ inch (3 cm), or 6 to 7, standard laryngeal mirrors and a head mirror reflector are used

PROCEDURE

The patient sits erect in a nose and throat chair with an adjustable stool. The camera is set rigidly on a tripod directly in front of the patient, and its height is adjusted so that the lens is in direct line with, and 10 to 12 inches (25 to 30 cm) from, the mouth of the patient. This distance varies slightly with different patients, depending on the size of the head and mouth. Illumination is provided by a projector or other source of light placed to the right of the patient so that the beam is directed on the head mirror of the operator and reflected and con-



Fig 3—Setup of apparatus used in this procedure

centrated on the laryngeal mirror, which when held in the proper position and at the correct angle will reveal the image of the larynx.

The field of vision is then brought into focus in the lens of the camera by adjusting the angle of the camera so that it will be in the direct line of the reflected rays (fig 3)

The diaphragm opening of the lens depends on three factors (1) the concentration of light, (2) the type of film used and (3) the distance of the lens from the object

For example, we have found that with an illumination of 750 watts from a projector and with the patient 12 inches (30 cm) from the camera a diaphragm opening of $f/80$ is most satisfactory when one is using Kodachrome A film

However, it is recommended that a photometer be used to determine the amount of light that is being reflected into the pharynx in each individual case and the



Figure 4



Figure 5

Fig 4—Normal larynx with complete adduction of the vocal cords

Fig 5—Normal larynx, with partial adduction of the vocal cords



Figure 6



Figure 7

Fig 6—Normal larynx, showing the posterior commissure of the vocal cords

Fig 7—Bilateral nodules of the anterior third of the vocal cord



Figure 8



Figure 9

Fig 8—Paralysis of the left vocal cord

Fig 9—Benign stenosis of the larynx



Fig 10—Benign stenosis of the larynx



Figure 11

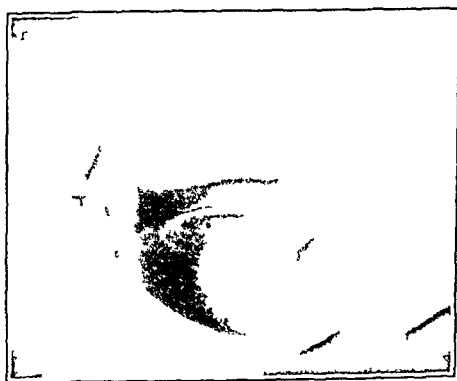


Figure 12

Fig 11—Infiltrating carcinoma of the larynx

Fig 12—Infiltrating carcinoma of the larynx

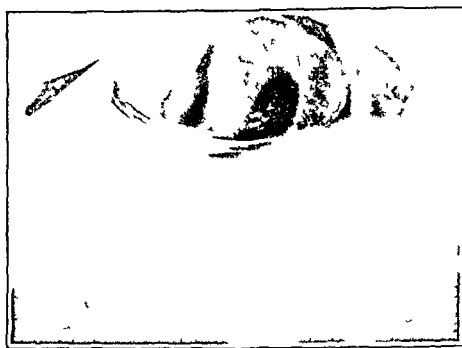


Fig 13—Early carcinoma of the left vocal cord viewed posteriorly

lens setting be made accordingly. By this method, we have photographed the larynges of over 100 patients, with conditions ranging from a normal to an extreme pathologic state.

The photographs here presented are enlargements of single frames of 16 mm film reproduced in black and white instead of the colors of the original Kodachrome film.

In all our photography the speed of the camera has been 16 frames per second.

CONCLUSION

A simplified method of laryngeal photography is here presented. The larynx is photographed by mirror laryngoscopy and the old cumbersome method thus eliminated.

By this method it is unnecessary to subject the patient to an operative procedure, such as direct laryngoscopic examination and the suspension method require.

The procedure may be carried out in the office without undue preparation and without waste of time.

Laryngeal photography should be encouraged, as it offers an invaluable means of obtaining permanent records of observations, not only useful for future reference but also extremely important for teaching.

Laryngeal photography offers tremendous opportunity for more accurate study of normal and abnormal states of the human larynx.

CONGENITAL TRACHEOESOPHAGEAL FISTULA WITHOUT ATRESIA OF THE ESOPHAGUS

REPORT OF A CASE WITH PLASTIC CLOSURE AND CURE

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NEW YORK

Congenital tracheoesophageal fistulas are not common. This is fortunate, for a child so afflicted rarely lives longer than a month after birth, usually succumbing within a few days. The condition is invariably accompanied by esophageal atresia, either above or below the stricture.

The fistula that was found and eventually closed in the patient considered in this report was about $\frac{1}{2}$ inch (1.3 cm) long and located in the party wall of the trachea and esophagus. It was opposite the ends of the third, fourth and fifth tracheal rings. It was slitlike in appearance and a trifle to the left of the sagittal plane.

At the beginning of the act of swallowing it was closed, but as the larynx receded there was dilatation of the opening, which could be seen from the tracheal side. There was a partial diaphragm of muscle and mucous membrane on the esophageal side, so that when the fistula dilated the posterior wall of the esophagus could not be seen. The opening on the tracheal side was lower than on the esophageal side. Figure 1, a schematic drawing of the tracheoesophageal fistula, shows this. There were spastic reactions of the pylorus and the cardia. For a time, most of the treatment was directed toward dilation of the cardia, by administration of antispasmodics, sedation and mechanical dilation. Also an abdominal operation for the relief of the pylorospasm was done, but with no apparent benefit (fig. 2).

EMBRYOLOGIC AND ETIOLOGIC CONSIDERATIONS¹ AND INCIDENCE

The esophagus and trachea are developed as an outgrowth from the entodermal alimentary canal. The first step in the development of the pulmonary system is a pouching of the ventral wall of the esophagus throughout its entire length. The ventral wall or groove deepens until its edges finally meet and fuse. In this manner, the groove becomes a tube which is separate from the esophagus, beginning at the gastric end.

Read at the Sixty-First Annual Meeting of the American Laryngological Association, Rye, N. Y., May 25, 1939.

¹ Keibel, F., and Mall, F. P. *Manual of Human Embryology*, Philadelphia, J. B. Lippincott Company, 1912, vol. 2, p. 313.

and extending toward the pharynx. This separation is not complete, however, until a bifurcation takes place which gives rise to the pulmonary portion below. The tube above does not as yet separate. At first, the invagination consists of entoderm, but later it fuses with the mesoderm. The trachea is the elongated stalk of the pulmonary system. At an early period two dorsoventral ridges appear at the junction of the trachea with the esophagus.

Keibel and Mall,¹ Reitter,² Holderman,³ Kreuter⁴ and Krauss⁵ expressed agreement that the cause of the fistula is an interference of mesoderm with entoderm at its site.

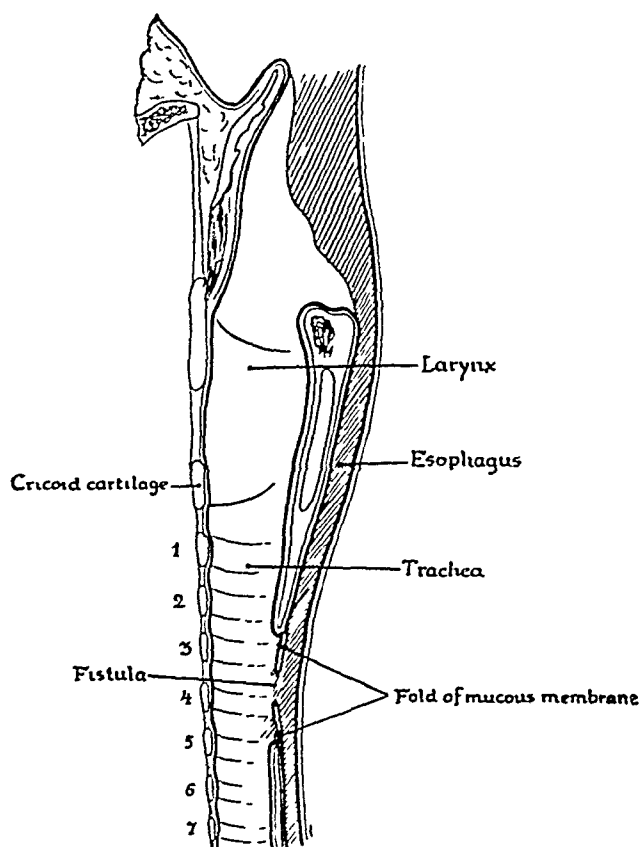


Fig 1—Schematic drawing showing the tracheoesophageal fistula

2 Reitter, G. S. A Case of Congenital Atresia of the Upper End of the Esophagus, *Radiology* **21** 587 (Dec.) 1933

3 Holderman, A. H. Congenital Atresia of the Esophagus, with Esophageal Diverticulum and Tracheo-Esophageal Fistula, *Arch Surg* **14** 917 (April) 1927

4 Kreuter, E. Die angeborenen Verschlüssungen und Verengerungen des Darmkanals im Lichte der Entwicklungsgeschichte, *Deutsche Ztschr f Chir* **79** 1, 1905

5 Krauss, F, in Nothnagel, H. *Specielle Pathologie und Therapie*, Vienna, A. Holder, 1902, vol 16, p 96

The fusion of the tracheoesophageal septum differentiates the esophagus and the trachea into two separate structures. Failure of this development results in the anomaly. However, most fistulas of the esophagus are just above the bifurcation of the trachea, for that is the last place to fuse in the development and differentiation of the trachea and esophagus. Almost all the case reports⁶ mentioned the presence of other defects, such as atresia of the esophagus, absence of the esophagus, pouches of the esophagus above or below the bifurcation of the trachea, double esophagus, imperforate anus, double uteri, deformities of the phalanges, an anomalous right subclavian aorta arising from the descending aorta, abnormalities of the hand or heart and extra ribs.

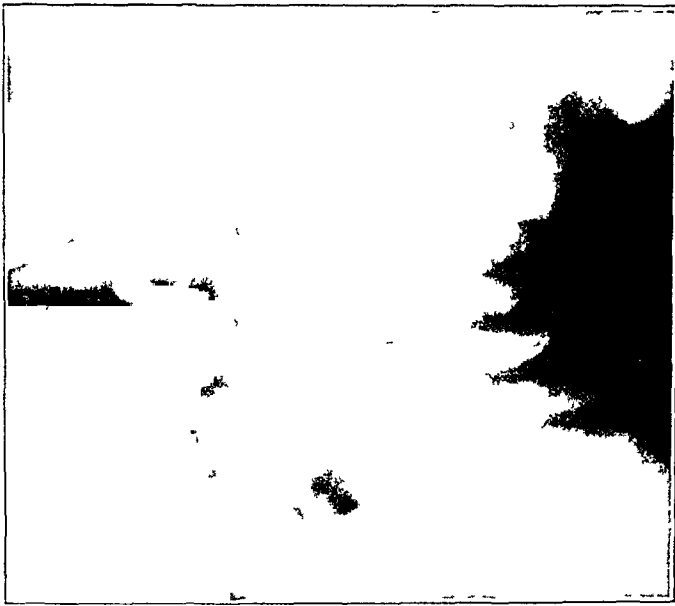


Fig 2—Roentgenogram showing a ureteral catheter passed from the larynx through the fistula into the esophagus

Rosenthal⁷ concluded that the development of the anomaly seems to rest on the early fundamental change in the entodermal cells that give rise to the esophagus and not on primary concomitant abnormalities. This change may be genetic.

MacKenzie⁸ stated that "the same male occasionally produces a similar deformity in the offspring of different females. There is no instance on record in which the same female has, by different males, given birth to infants with a similar deformity."

6 O'Hare, H. A. Imperforate Anus and Tracheo-Esophageal Fistula, *Pennsylvania M J* **40** 914 (Aug) 1937

7 Rosenthal, A. H. Congenital Atresia of the Esophagus with Tracheo-Esophageal Fistula, *Arch Path* **12** 756 (Nov) 1931

8 MacKenzie, M. A Manual of Diseases of the Throat and Nose, New York, William Wood & Company, 1884, vol 2, pp 223 and 230

In giving a detailed report regarding a child with a two pouch type of deformity of the esophagus, he related the case of a father whose children by two different wives had similar deformities, both children died within nineteen days

All the case reports of Holdeiman, Mathien and Goldsmith,⁹ Reitter, Rosenthal, Plass,¹⁰ Kasselbohm and Schreiber,¹¹ McNamara and Lytle¹² and many others have described lesions of the esophagus with fistulas into the trachea in the neighborhood of the bifurcation of the trachea and with an accompanying malformation of the esophagus

A case report found in the literature and dated 1696 was cited by McClellan and Elterich¹³

Up to 1917 Plass, who reviewed the subject thoroughly, found 204 cases Reynolds and Morrison¹⁴ placed the number at 214 in 1921 In 1922 Steffen and Willard each reported a case, making 216 McClellan and Elterich added a case, and then Holdeiman³ reported another case, so that by 1927 a total of 218 cases had been reported O'Hare in 1933 reported a case and brought the number up to 281 Rosenthal in 1937 reported 3 cases The rarity is probably due to faulty diagnosis, as shown by Bienneman, cited by Holdeiman

Probably 300 such cases have now been reported in the literature¹⁵

However, there have been few, if any, reports of cases in which the fistula was high and atresia or deformity of the esophagus was not present This type of tracheoesophageal fistula must, indeed, be a rarity, as Terracol¹⁶ stated in his comprehensive treatise on diseases of the esophagus

REPORT OF CASE

The following history was submitted by Dr Raymond L Sippel, the patient's father

9 Mathien, A, and Goldsmith, H E Congenital Atresia of the Esophagus with Tracheo-Esophageal Fistula, *Am J Surg* **22** 233 (Nov) 1933

10 Plass, E D Congenital Atresia of the Esophagus with Tracheo-Esophageal Fistula Associated with Fused Kidney A Case Report and a Survey of the Literature on Congenital Anomalies of the Esophagus, *Johns Hopkins Hosp Rep* **18** 259, 1919

11 Kasselbohm, F A, and Schreiber, M J Tracheo-Esophageal Fistula and Complete Esophageal Stenosis of the Newborn, *Am J Obst* **32** 509 (Sept) 1936

12 McNamara, F P, and Lytle, C C Finley Hospital Clinico-Pathologic Conference, *J Iowa M Soc* **26** 526 (Sept) 1913

13 McClellan, R H, and Elterich, T O Congenital Atresia of the Esophagus Report of Two Cases, *Arch Pediat* **51** 171 (March) 1934

14 Reynolds, R P, and Morrison, W W Congenital Malformations of the Esophagus, *Am J Dis Child* **21** 339 (April) 1921

15 Ross, F E, in discussion on O'Hare⁶ Imperatori, C J, and Burman, H J Diseases of the Nose and Throat, Philadelphia, J B Lippincott Company, 1935, p 557 Ross stated that he had had 6 such cases up to January 1936

16 Terracol, J, Baumel, J, and others Les maladies de l'œsophage, Paris Masson & Cie, 1938, p 127

"Past History"—Robert R Sippel, born prematurely on Sept 23, 1931, weighed 5½ pounds (2,494.6 Gm) at birth. In September 1937 he weighed 34 pounds (15.4 Kg). At the time of writing (April 1939) he weighs 44 pounds (20 Kg).

"The child was difficult to feed since birth, he could tolerate only thick feedings. Administration of atropine sulfate was started during the first few weeks of life. He had bronchopneumonia at the age of 6 months (probably because of aspiration), at the age of 2 years and at the age of 5 years. His sleep was always disturbed because of a cough.

"Laparotomy in 1936"—A single adhesion, about the width of a match stick, which stretched tightly across the pylorus and caused retention of food, was divided. A series of gastrointestinal roentgenograms showed four hour retention. In comparison with the results of a series made the year before there was a decided delay in the emptying time.

"Dilation of Esophagus"—Dilation of the esophagus (cardia) was done four times by Dr Louis H Clerf, Jefferson Hospital Annex, Philadelphia, in 1936.

"The difficulty in retaining food became greatly aggravated at this time, the patient would swallow a certain amount of food or liquid, and after a few minutes the entire amount, together with an extremely large amount of thick, tenacious mucus, would be regurgitated, this was not accompanied by nausea. The child would immediately return to the table and attempt to eat again, after which the same process would be repeated.

"There were intervals sometimes as long as ten to fourteen days when a great deal of food was retained. It was because of this regurgitation that he was taken to Dr Clerf in Philadelphia.

"The dilations by Dr Clerf seemed to improve him, but they were exhausting. At that time he was 4½ years of age and weighed between 25 and 30 pounds (11.3 and 13.6 Kg), so that in spite of Dr Clerf's advice they were discontinued after the fourth dilation.

"Tonsillectomy"—This was done in 1937.

"Dilation of Esophagus and Subsequent Course"—Dilation of the esophagus was performed twice by Dr Girard F Oberrender, of New York, in October 1937. At that time the symptoms, which had not been too strongly marked, became greatly exaggerated, and for three days the patient retained practically no food or liquids. He was then admitted to the New York Hospital under the care of Dr Oscar M Schloss. After a series of gastrointestinal roentgenograms and further study, he was referred to Dr Oberrender at Lenox Hill Hospital. At that hospital, the esophagoscope was used twice with the patient under anesthesia induced by avertin with amylene hydrate, which had to be reenforced by general anesthesia. It was then decided to adopt the procedure of having him swallow a long string on which to thread a bougie, the string to guide the bougie through the esophagus.

"A short time after beginning the swallowing of the string he did not do well, although he continued to swallow the string until 12½ yards (11.43 meters) had been swallowed. No food or liquids were retained, and the cough became very annoying. In the meantime, the nurses' notes stated, 2 yards (1.83 meters) of string was recovered from the rectum. This excess string was cut off with a scissors. The patient was taken home and became progressively worse, coughing almost continuously and retaining no food and practically no fluids.

"This continued for three days, when he was seen by Dr Daniel S Cunniff of New York, who made a tentative diagnosis of abscess of the lung. He was admitted to the Manhattan Eye, Ear and Throat Hospital on November 4, and further examination disclosed a piece of string in the larynx.

"On November 5 an attempt to remove this string resulted in sudden asphyxia, and an emergency tracheotomy was performed by Dr Cuning. The patient was immediately taken to the bronchoscopic room and 9½ yards (8.69 meters) of string was removed from the right bronchus by Dr David Jones. The remainder, 44 inches (112 cm), was removed five days later by Dr Jones. The entire amount of string removed measured 10 yards and 26 inches (9.8 meters).

"The patient was discharged from the hospital on December 27. During all this time he was unable to swallow any food or liquids and was fed by means of a Levine tube. In spite of his acute illness, he was gaining weight because of a diet of high caloric content and good nursing care.

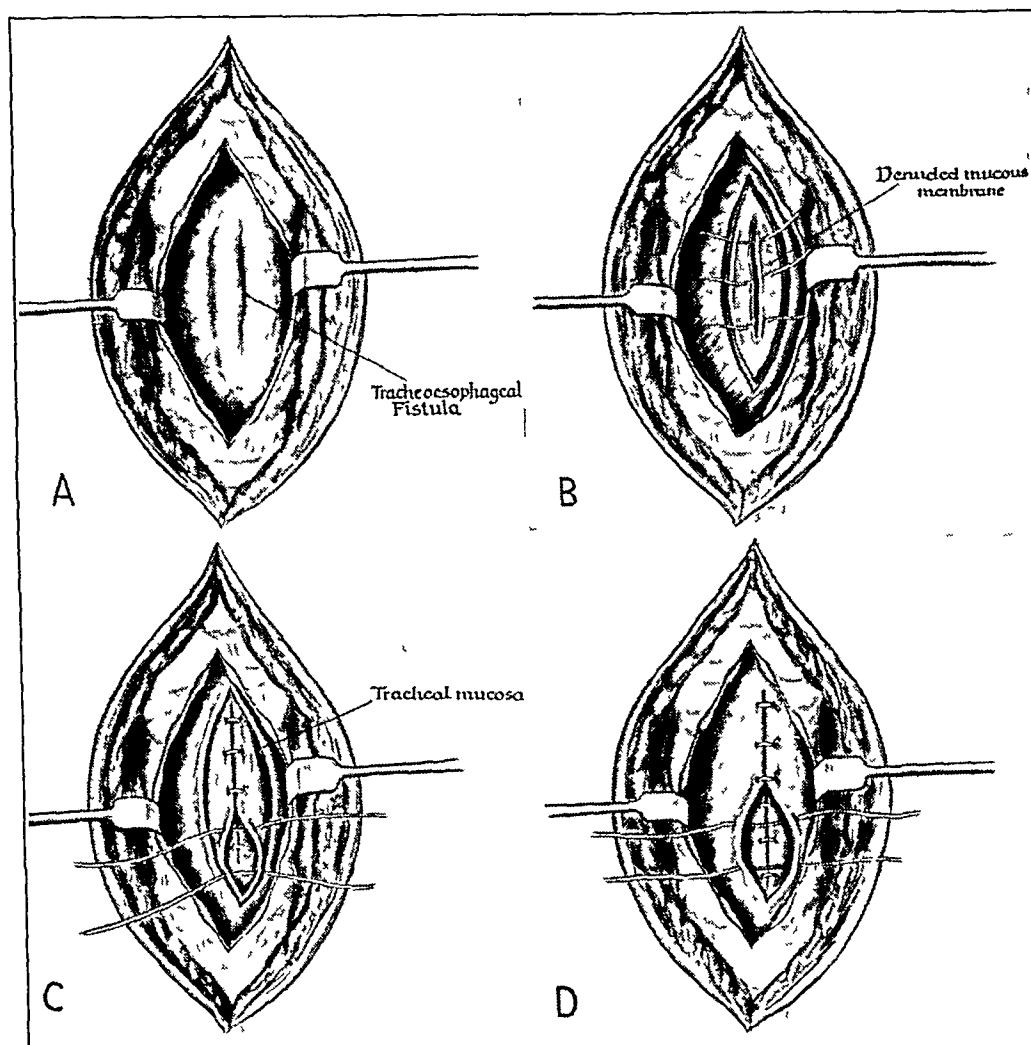


Fig 3—A, tracheoesophageal fistula exposed and tracheal walls retracted, retraction inverts the posterior tracheal wall and the fistula into the lumen of the trachea. B, elliptic incision encircling the fistula, the shaded area shows undermining of the tracheal mucosa, the edges of the fistula were freshened with denudation of adjacent mucous membrane. C, party wall, including the submucosal tissues sutured together, burying the fistula, tracheal mucosa as yet not sutured. D, tracheal mucosa being approximated.

"The patient was admitted to the Chevalier Jackson Bronchoscopic Clinic at Temple University Hospital on Feb 5, 1938. He was acutely ill, with a temperature of 104 F, coughing almost continuously and expectorating more than a pint

of sputum a day. The physical signs were those of bronchopneumonia or of an acute tuberculous process. The acute condition gradually subsided, and the temperature finally reached 99 F. Although the diagnosis of tuberculosis had been made, Dr Cuning insisted on the patient being examined with the bronchoscope, and on February 16 this was done by Dr C L Jackson, and a large tracheoesophageal fistula was found. This observation was later substantiated by roentgen findings, the fistula was localized at about the level of the fifth tracheal ring. The patient was discharged from Temple University Hospital on February 24.

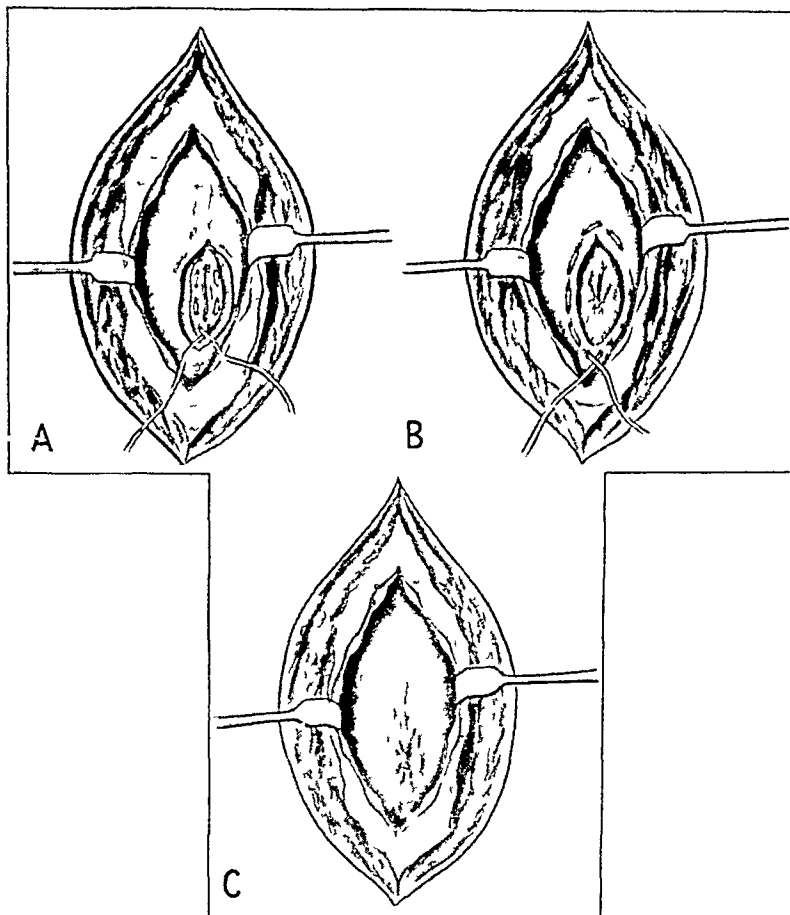


Fig 4—A, remains of the fistula exposed, purse string suture inserted in the esophageal wall after denudation of the edges of the fistula. B, suture drawn together and purse string suture placed in the tracheal mucosa. C, suture drawn together, showing some deformity of the posterior tracheal wall.

"He had been at home about two weeks when another attack of acute bronchopneumonia (aspiratory) caused his parents to seek immediate aid. He was readmitted to the Manhattan Eye, Ear and Throat Hospital on March 10, under the care of Dr Charles J Imperatori.

"After the acute condition had subsided, Dr Imperatori was successful in passing a ureteral catheter through the tracheal fistula and into the stomach. A roentgenogram was then taken with the catheter in place, so that the presence of the fistula was proved and more accurate localization obtained.

"The patient was operated on by Dr Imperatori on March 18, 1938, for closure of the fistula. He was still unable to swallow food or fluid after this operation, and on May 11 a second operation was performed. While at the first operation the fistula had been found to be about $\frac{1}{2}$ inch (1.3 cm) in length, the second time it was of such size as to admit only a small probe. The remaining fistula was closed with a purse string suture of chromic gut and a second purse string suture invaginating the first layer of sutures.

"The tracheotomy tube was not inserted at the second operation.

"Since then the child has been able to eat and swallow liquids and solid food. The only difficulty experienced is that the process of eating is slow, he may still have some cardiospasm, but the tracheoesophageal fistula has been entirely closed."

Comment—The diagnosis was originally cardiospasm and pylorospasm, and there was definitely confirmed diagnosis of many attacks of bronchopneumonia undoubtedly aspiration pneumonias.

Roentgenograms of the chest, because of repeated attacks of food aspiration, were confusing. This, coupled with high temperature and emaciation, suggested a diagnosis of tuberculosis.

Tracheoscopic examination revealed the fistula into the esophagus.

The accident of the swallowing of the string and its removal was a near tragedy. The severe coughing following the swallowing of the string should have suggested the possibility of its being in the trachea. When told of this, I ventured that the string had been looped in the larynx, although in a general discussion it was suggested that a fistula might be present. The fistula was slitlike, and it is possible that there was sufficient sphincteric action of the upper fibers of the cricopharyngeus muscle or stretching of the tissues during the act of swallowing to keep the fistula closed most of the time (fig 4C). It appears that after the "string swallowing," with regurgitation of the string through the fistula into the respiratory tract, there was sufficient disturbance of the fistula to destroy its sphincteric action. There was, undoubtedly, at times severe cardiospasm.

The first operation to close the fistula, which was done on March 18, 1938, and is shown in figure 3, was performed with the idea of not causing any change in the trachea or the esophageal lumen. It was almost a success.

The second operation (fig 4) was done on May 11, 1938, and the remaining fistula was so small that a purse string suture could be used without danger of lessening the tracheal lumen. It is possible that had chromic catgut been used at the first operation it would have been successful. Silk was used. Three of the five silk sutures were recovered at the second operation. The symptoms of cardiospasm have disappeared.

It is now one year after operation, and the boy has gained 10 pounds (4.5 Kg) and grown 2 inches (5 cm).

NEUROLOGIC COMPLICATIONS OF INFECTIONS OF TEMPORAL BONE AND PARANASAL SINUSES

SUMMARY OF TWENTY YEARS' (1919 TO 1938) EXPERIENCE

JOSEPH C YASKIN, M D

PHILADELPHIA

(Concluded from page 182)

NONSUPPURATIVE ENCEPHALITIS

Oppenheim³⁹ in 1900 and Voss⁴⁰ in 1902 described cases of non-purulent encephalitis associated with aural infections. They stated the belief that the condition represents a stage in the development of a true abscess but that the encephalitis has failed to progress to supuration. Borries⁴¹ in 1921 expressed the belief that otogenic encephalitis is a pathologically different process from that form of encephalitis which leads to the formation of abscess. Adson⁴² in 1924 described cases in which symptoms and signs of an abscess of the brain were present but on exploration only an accumulation of fluid in the subarachnoid space and congestion of cerebral convolution appeared. He attributed the clinical picture to localized encephalitis and termed it "pseudobrain abscess". Yerger⁴³ in 1925 and Symonds⁴⁴ in 1927 described cases in which evidences of increased intracranial pressure and focal disease of the brain associated with disease of the temporal bone and sinus were presented but no meningitis or abscess appeared on exploration and recovery resulted from the procedures. Similar cases have been reported by Cairns,⁴⁵ Key-Aberg,⁴⁶ Voss⁴⁷ and others.

39 Oppenheim, H. Zur Encephalitis acuta non purulenta, Berl klin Wchnschr **37** 201, 1900

40 Voss, F. Drei Falle von Encephalitis im Anschluss an Otitis media, Ztschr f Ohrenh **41** 223, 1902

41 Borries, G. V. T. Otogenous Encephalitis, Hospitalstid **64** 545, 1921, Ztschr f d ges Neurol u Psychiat **70** 93, 1921

42 Adson, A. W. Pseudobrain Abscess, S Clin North America **4** 503, 1924

43 Yerger, C. G. Acute Toxic Meningo-Encephalitis of Otorhinogenic Origin, Arch Otolaryng **1** 198 (Feb) 1925

44 Symonds, C. P. Some Points in the Diagnosis and Localization of Brain Abscess, J Laryng & Otol **42** 440, 1927

45 Cairns, H. Abscess of the Brain, J Laryng & Otol **45** 385, 1930

46 Key-Aberg, H. Contribution a l'étude de l'encephalite otogene, Acta oto-laryng **10** 75, 1926

47 Voss, O. Otitis media und Encephalitis, Ztschr f Hals-, Nasen- u Ohrenh **21** 596, 1928

The review of the literature indicates that nonsuppurative encephalitis of variable severity originating from disease of the temporal bone or sinus gives rise to symptoms of focal disease of the brain, with or without evidences of increased intracranial pressure and with slight fever and pleocytosis in most cases. When localized, nonsuppurative encephalitis may simulate abscess of the brain, from which it can be differentiated only by observation and in some cases only by intracranial exploration. Failure to find suspected abscess on intracranial exploration need not mean that the abscess was missed or that further exploration is indicated, if the patient shows continuous improvement. Early and thorough removal of foci and establishment of drainage are important in all cases. These measures may in some cases lead to recovery and prevent unnecessary intracranial explorations, as is shown by the cases in this series.

In this series there were 5 cases of nonsuppurative encephalitis, 2 of otitic (cases 11 and 12) and 3 of sinus origin (cases 13, 14 and 15), and because of their special interest all cases are abstracted.

OTITIC HYDROCEPHALUS AND ARACHNOIDITIS

Circumscribed serous meningitis, otitic arachnoiditis and pseudobrain abscess or tumor are names given by various writers to a number of unusual neurologic complications of otitis and disease of the paranasal sinus traceable to disturbance of the arachnoid and manifested by increased intracranial pressure, with or without changes in the spinal fluid or signs of focal involvement of the brain, in which the patient usually recovers promptly with the relief of the increased intracranial pressure. Shapiro⁴⁸ divided these conditions on pathologic grounds into four groups.

1 A fibrous and adhesive variety. This is common in the anterior but uncommon in the posterior fossa.

2 A cystic form. In this some part of the subarachnoid space, usually one of the cisterns, undergoes mild inflammation, resulting in obstruction of the normal circulation of the cerebrospinal fluid, with formation of a pseudocyst in the affected area. Grossly the arachnoid membrane is thickened and opaque, histologically there is infiltration of round cells in the arachnoid mesh and in some cases sclerotic changes in the underlying cortex. [Davis and Haven⁴⁹]

3 Internal hydrocephalus. This may be due to (a) inflammatory closure of one or more of the foramina in the ventricles, the aqueduct of Sylvius or the roof of the fourth ventricle, or (b) hypersecretion with so-called mechanical obstruction of the foramina.

48 Shapiro, S. L. Otogenic Aspects of Arachnoiditis, *Arch Otolaryng* **28** 546 (Oct) 1938.

49 Davis, L., and Haven, H. A. A Clinicopathologic Study of the Intracranial Arachnoid Membrane, *J Nerv & Ment Dis* **73** 129 and 286, 1931.

4 Generalized intracranial hypertension There is a free flow through the subarachnoid space, but the condition is due to (a) hypersecretion or (b) obstruction to the normal absorptive channels by inflammation of the arachnoid villi

Shapiro further suggested

From a clinical aspect cases of arachnoiditis fall into three groups

A Cases in which the history and symptoms suggest a tumor of the brain

B Cases in which abscess of the brain appears probable

C Cases in which there is a relatively sudden rise of intracranial pressure with severe symptoms but with no focal signs

All three groups may possess an interest for the otologist, both from an etiologic and from a diagnostic point of view

In this series there were several cases which fall into this unusual category Case 16 is an illustrative one of adhesive arachnoiditis with symptoms simulating a tumor of the brain, while in cases 11, 12 and 13 the possibility of abscess of the brain was suggested

The third type, otitic hydrocephalus, probably deserves most consideration, although it is uncommon and probably not a distinct clinical entity It is acute or subacute hydrocephalus occurring in association with disease of the temporal bone The literature on the evolution of the concept of otitic hydrocephalus was fully and critically reviewed by Williams⁵⁰ Symonds,⁵¹ who suggested the name otitic hydrocephalus, stated "The condition appears almost confined to children and adolescents It may occur as a complication of an acute or chronic otitis media, with or without meningitis" The pathologic picture of the condition is not known except that there is "either an excessive secretion from the choroid plexus or a defective absorption through the arachnoid villi" Some authors hold that there may be an inflammatory condition of the meninges (Williams⁵⁰)

According to Symonds, "in the fully-developed state intermittent headache and papilloedema are the most constant [symptoms] A sixth nerve paralysis on the side of the discharging ear has been recorded in a number of cases" The headache may be severe and may be accompanied by nausea or vomiting The papilledema may be high and may be followed by optic atrophy Drowsiness is occasionally present, but as a rule the child is clear mentally The onset 'may be insidious, or [symptoms] may develop after a preliminary phase of fever and cervical rigidity"

The cerebrospinal fluid in the fully-developed state is under increased pressure, but clear and contains no excess of cells or protein In those cases in which there is a preliminary phase of meningitis, the fluid examined at this stage shows

50 Williams, H L Otitic Hydrocephalus, Arch Otolaryng **25** 632 (June) 1937

51 Symonds, C P Otitic Hydrocephalus, Brain **54** 55, 1931

pleocytosis and an increase in protein The course of the illness may be protracted to weeks or months but leads towards complete recovery

In some cases, however, impairment of vision results from optic atrophy

In the treatment of otitic hydrocephalus the first requisite is surgical attention to the local disease of the temporal bone, removing foci of infection and establishing good drainage. The next procedure of importance is lumbar puncture, which may be repeated if recurrent headache or persistent papilledema exists. "If repeated lumbar puncture fails to relieve the symptoms, ventricular puncture should be undertaken." If doubt exists regarding the presence of an abscess, an intracranial exploration is indicated.

The differentiation from a cerebral abscess is obviously difficult and often cannot be made without exploration. Symonds stressed that in these cases the constant headache, the signs of focal involvement of the brain and the increase in cells and protein in the spinal fluid, frequently found with abscess of the brain, do not occur.

In this series there were 2 cases of otitic hydrocephalus (cases 17 and 18), which are abstracted.

THROMBOSIS OR PHLEBITIS OF THE INTRACRANIAL VENOUS CHANNELS

Thrombosis or phlebitis of the lateral sinus, the cavernous sinus, the superior longitudinal sinus, the petrosal sinuses or the cerebral or cerebellar veins may be caused by infections of the temporal bone and paranasal sinuses and in turn give rise, by venous obstruction, retrograde extension of infection or venous stasis, to subdural or subarachnoid hemorrhage, subdural, cerebral or cerebellar abscess, encephalitis or meningitis.

- *Thrombosis of the Lateral Sinus*—Nielsen and Courville,⁵² in a study of 15,000 autopsies, found 43 cases of thrombosis of the lateral sinus, in 4 of which the condition was bilateral. In the 43 cases, 15 patients had septic meningitis, 7 had abscess of the brain, 2 had subdural, and 2 extradural, abscesses, and 4 had subdural hemorrhage. Coates, Ersner and Persky⁵³ reported involvement of the lateral sinus in 14 of 969 cases in which mastoidectomy was performed in eleven years (1.4 per cent). These figures agree with those of many other large series reported. The mortality varies from 14 to 35 per cent with different surgeons. The infection may take place (a) by an extravascular route or (b) by intravascular extension. Thrombosis of the lateral sinus

⁵² Nielsen, J. M., and Courville, C. B. Intracranial Complications of Orogenous Thrombosis of Lateral Sinus, *Ann Otol, Rhin & Laryng* **46** 13, 1937.

⁵³ Coates, G. M., Ersner, M. S. and Persky, A. H. Lateral Sinus Thrombosis with a Review of the Literature. *Ann Otol, Rhin & Laryng* **43** 419, 1934.

may be (a) simultaneous with the otitic infection and mastoiditis, (b) postoperative or (c) latent in chronic infections

The symptoms of thrombosis of the lateral sinus include the following types (1) systemic—elevation in temperature, usually of the stepple-chase variety, chills or chilly sensations, parallel acceleration of the pulse, sweats, leukocytosis, gradually developing anemia, a positive blood culture in over 50 per cent of cases and metastatic abscesses, (2) local—tenderness over the jugular vein, slight defensive rigidity of the neck and adenitis, (3) cerebral—headache, evidences of increased intracranial pressure, involvement of the nerves in the posterior fossa, bacterial meningitis, cerebral or cerebellar abscess and Horner's syndrome

The headache may be due to sepsis, to the local process or to increased intracranial pressure, which is ascribed to the occluding thrombus causing venous damming in the petrosal and cavernous sinuses (Eagleton⁵⁴) The opposite lateral sinus must carry the major outflow from the skull, in the presence of anomalies in size (Ersner and Myers⁵⁵) the opposite sinus may be small and unable to drain the venous system, and marked intracranial pressure may result

An increase in spinal fluid pressure occurs, often accompanied by an increase in cells

Choking of the disks may occur White⁵⁶ found papilledema in 33 of 62 cases and Atkins⁵⁷ in 17 of 40 cases, and Blau⁵⁸ found 17 cases of optic neuritis and 13 cases of choking in 162 cases The optic swelling disappears with lumbar puncture, dehydration and administration of hypertonic solutions

The present series comprises 19 cases, in 9 of which evidences of thrombosis of the lateral sinus were present at the time of the first operation (on the right in 6 and on the left in 3) and in 10 of which they developed subsequent to mastoidectomy (on the right in 4 and on the left in 6)

In the 19 cases, 7 patients died, and in all but 1 the condition was accompanied by intracranial complications In the 7 fatal cases, 3

54 Eagleton, W P Circulatory Disturbances Following Ligation of Internal Jugular Vein, *Arch Otol & Laryng* **35** 91, 1906

55 Ersner, M S, and Myers, D An Aid to the Diagnosis of Intracranial Complications Resulting from Venous Circulatory Disturbances of the Temporal Bone, *Laryngoscope* **43** 800, 1933

56 White, J W Study of Lateral Sinus Thrombosis, *Laryngoscope* **36** 96, 1926

57 Atkins, R T A Report of Forty Cases of Lateral Sinus Thrombosis, *Laryngoscope* **36** 96, 1926

58 Blau, cited by Braun, A Sinus Thrombophlebitis, New York, Paul B Hoeber, 1928

patients had abscess of the brain (1 temporosphenoid and 2 cerebellar), 2 of the abscesses being associated with bacterial meningitis, 1 had meningitis and subdural abscess, 1, meningitis, 1, thrombosis of the superior longitudinal sinus, and 1, septicemia

In the 19 cases 11 patients had neurologic complications

Of the 19 cases studies of the eyes were made in 11, in which 4 patients had bilateral papilledema, 2 had unilateral papilledema (1 ipsilateral and the other contralateral), 2 had venous congestion of the fundi and 3 presented normal fundi

In the 19 cases, 3 patients had abscess of the brain, 1 subdural abscess and 4 bacterial meningitis

In the 19 cases, 4 patients presented evidences of meningeal irritation accompanied by some evidences of increased intracranial pressure, and all recovered. Of the 4 patients, 3 had choking of the optic disks, and none had pleocytosis of the spinal fluid

Thrombosis of the Cavernous Sinus—Courville and Rosenfold⁵ tabulated a number of series of cases reported, by ten authors and including their own, and found that the most common causes of thrombosis of the cavernous sinus are, in the order mentioned, (a) infections about the face, the eyes, the orbits, the lips and the side of the nose, (b) infections of the ear and mastoid, (c) sinal and intranasal infections, (d) oral and dental infections, (e) infections of the throat, and (f) infections of the nares

When associated with disease of the temporal bone, thrombosis of the cavernous sinus is usually secondary to thrombosis of the lateral or the petrosal sinus, to associated disease of the paranasal sinuses, to orbital infection or to unrecognized disease in the opposite temporal bone, as in case 19 of this series

Thrombosis of the cavernous sinus may follow infection of any of the sinuses, but sphenoiditis is responsible for it in more than half of the cases (Turner and Reynolds³) This frequency is ascribed to the direct connections between the veins draining the sphenoid sinus and those draining the cavernous sinus, or the carotid venous plexus. When the thrombosis is secondary to ethmoiditis or frontal sinusitis, it is usually preceded by orbital cellulitis and thrombosis of the ophthalmic and ethmoid veins. When it follows submucous resection or septal abscess, the infection travels by way of the ethmoid or sphenopalatine veins, which drain into the pterygoid plexus and thence into the cavernous sinus. It may follow inflammation of the maxillary sinus, the infection traveling by way of the orbit or the pterygoid plexus. It is occasionally associated with pachymeningitis interna and much more commonly with septic leptomeningitis

In this series there were 11 cases. In 4 it followed dental extraction, in 3, infections about the face, in 2, sinus infection (in 1 of these it followed removal of a polyp), and in 2, chronic otitis and mastoiditis. In 1 of the last-mentioned cases it was associated with labyrinthitis and an extracerebellar abscess. In 3 cases the patient had frank meningitis and in 1 only meningeal irritation. Only 3 patients in the 11 cases had bilateral involvement. The rest succumbed before the process had a chance to extend to the contralateral side.

The clinical picture in these cases is uniformly terrifying. Evidence of an overwhelming systemic infection and proptosis of first one eye and then the other, accompanied by immobility of the eyeball are followed by evidences of meningitis. Edema of the eyelids and chemosis of the bulbar conjunctiva depend on the origin of the infection.

Thrombosis of the Superior Longitudinal Sinus—A rare condition, thrombosis of the superior longitudinal sinus is secondary to frontal sinusitis or to disease of the temporal bone, especially thrombosis of the lateral sinus. According to Courville and Rosenvold,⁵ Killian⁵⁹ stated that there were four possible pathways which might be traversed from the frontal to the superior longitudinal sinus:

(1) through bone by direct or indirect extension, (2) through the diploic veins, some of which ultimately drain into the superior longitudinal sinus, by infection with osteomyelitis, (3) through vascular connections between the frontal and the superior longitudinal sinus, and (4) through communication between the veins of the galea (infected by osteomyelitis) and the superior longitudinal sinus, by way of the parietal emissary vein.

It is said to occur most commonly in children suffering from malnutrition, anemia and dehydration.

Thrombosis of the superior longitudinal sinus is associated with thrombosis of the superior cerebral veins, extradural and subdural abscess, intracerebral abscess and septic leptomeningitis.

The clinical manifestations of thrombosis of the superior longitudinal sinus are vague. The clinical picture is often masked by the symptoms of the primary diseases and by thrombosis of the lateral sinus. The syndrome which was considered characteristic of the occlusion of the superior longitudinal sinus, i. e., alternating jacksonian convulsions, ending in hemiplegia, was shown by Nielsen and Courville⁵² to occur as frequently in thrombosis of the lateral sinus. Fatal termination is the rule.

In this series there were 4 cases, 3 of children. In 1 case the thrombosis was associated with thrombosis of the lateral sinus, in another with bronchopneumonia and in 2 with disease of the frontal sinus and extradural abscess. In all there were convulsions and hemiplegia.

⁵⁹ Killian, G. Die Thrombophlebitis des oberen Langsblutleiters nach Entzündung der Stirnhohlenschleimhaut, *Ztschr. f. Ohrenh.* 37:343, 1900.

CRANIAL NERVES

It seemed useless to study the diseases of the olfactory nerve among neurologic conditions associated with disorders of the temporal bone and paranasal sinuses. Retiobulbar neuritis, lasting painful conditions associated with sinus disease and repeated operations and Ménière's syndrome will be presented in a later contribution. The simultaneous involvement of the ninth, tenth and eleventh cranial nerves in the region of the jugular foramen or isolated involvement of the last four nerves was not encountered in this series. The discussion will therefore be limited to the optic nerve, the nerves supplying the extraocular muscles, the trifacial and the facial nerve.

Optic Nerve—Retiobulbar and optic neuritis caused by sinus disease will be presented in a later publication. Papilledema ranging from slight congestion to several diopters of choking was found in this series in association with abscess of the temporal lobe in 8 cases, with abscess of the frontal lobe in 9 cases, with cerebellar abscess in 4 cases, with subdural abscess in 3 cases, with extradural abscess in 1 case, with arachnoiditis in 1 case, with otitic hydrocephalus in 2 cases, with nonsuppurative encephalitis in 3 cases and with thrombophlebitis of the lateral sinus in 8 cases.

The visual acuity in these cases differed with the degree of papilledema. Contralateral hemianopic defects were observed in 11 cases of abscess of the temporal lobe. In all other cases of papilledema the visual fields either were normal or showed a general contraction.

Nerves to the Extraocular Muscles—In all cases of thrombosis of the cavernous sinus there was complete implication of all the cranio-ocular nerves on one or both sides. This series has no instances of isolated implication of the trochlear nerve.

Oculomotor Nerve—Paralysis of the oculomotor nerve due to sinus disease has been dealt with in another publication (Yaskin⁶⁰), in which the interesting anatomic and pathologic factors responsible for the occurrence of this condition were discussed and 2 cases reported. In the present series varying degrees of oculomotor paralysis were found, in association with extradural abscess in 2 cases and with localized nonsuppurative encephalitis in 1 case.

Abducens Nerve—Involvement of the abducens nerve is rare in the course of disease of the paranasal sinuses, but it does occur alone or in combination with involvement of the oculomotor nerve (Yaskin⁶⁰). In this series it occurred in 1 case of nonsuppurative encephalitis, in 4

⁶⁰ Yaskin, J. C. Paralysis of the Extraocular Muscles. Clinicoanatomic Considerations, Report of Cases of Paralysis of the Oculomotor and Abducens Nerves Due to Unusual Causes, Arch Ophth **21** 1010 (June) 1939.

cases of abscess of the frontal lobe and in 1 case of subdural abscess (case 15). Paralysis of the abducens nerve is common in the course of disease of the temporal bone. It may occur (a) as evidence of increased intracranial pressure, (b) as a part of the Gradenigo syndrome, (c) as a symptom of apical petrositis (Yaskin and Kornblum⁶¹) or (d) in diffuse bacterial meningitis.

(a) As evidence of increased intracranial pressure paralysis of the sixth nerve is a late symptom and usually occurs in severe conditions. In this series it occurred in association with extradural abscess in 1 case (case 8), with abscess of the temporal lobe in 4 cases and with abscess of the frontal lobe in 4 cases.

(b) The Gradenigo syndrome consists of aural discharge with homolateral pain in the face and paralysis of the abducens nerve. It is due to localized meningitis in the region of the petrous apex associated with edema and pressure in Dorello's canal and was at one time regarded as a benign process, terminating in spontaneous recovery. In recent years, however, the recognition of the entity apical petrositis, which closely resembles the Gradenigo syndrome, renders the prognosis in cases of Gradenigo syndrome more guarded. In this series there were 5 cases of Gradenigo syndrome, in all of which it followed simple mastoidectomy, and all the patients recovered without subsequent operations.

(c) Apical petrositis was discussed in a previous publication (Yaskin and Kornblum⁶¹). Since that publication there has been only 1 additional, fatal, case, making a total of 8 cases, with paralysis of the abducens nerve due to apical petrositis in 3 cases.

(d) No reliable figures can be given regarding the frequency of occurrence of paralysis of the sixth nerve in the cases of bacterial meningitis in this series.

Trigeminal Nerve—The facial pain associated with chronic sinus disease, with Sluder's neuralgia and pain in the vidian nerve, and the psychalgias will be a subject of a later publication. Pain of one or more branches of the fifth nerve was found in the 5 cases of Gradenigo's syndrome, in all 8 cases of petrositis and in association with extradural or subdural abscess in most cases and with abscess of the temporal lobe in 2 cases.

Facial Nerve—The facial nerve is frequently implicated in the course of disease in either the petrous or the mastoid portion of the temporal bone. The paralysis may be complete or incomplete. It may occur preoperatively, may be produced at operation and observed during the

⁶¹ Yaskin, J. C., and Kornblum, K. Neurologic Aspects of Petrositis, *Arch Neurol & Psychiat* **37** 307 (Feb.) 1937.

operation or immediately thereafter or may appear sometime after the operation. According to Kerrison,¹² preoperative paralysis of the facial nerve

may result from any of the following conditions (1) Acute suppurative otitis media of severe type, the inflammatory process extending through the tympanic wall of the Fallopian canal, and the nerve being either directly involved or subjected to pressure by inflammatory products within the canal. This is commoner in young children than in adults. (2) During acute suppurative otitis media as a result of direct exposure of the nerve through a defect in the tympanic wall of the facial canal. (3) In chronic suppurative otitis media, the necrotic process involving the facial canal. (4) In suppurative labyrinthitis secondary to chronic middle-ear suppuration, a necrotic tract through the horizontal semicircular canal may by downward extension involve the facial. (5) Facial paralysis is an occasional accompaniment of otitic meningitis, in which case the nerve lesion is probably more often the result of an intermediate infection of the labyrinth than of an extension of inflammation from the meninges to the nerve-trunk as it traverses the internal auditory canal. (6) Tuberculous lesions. In a very large percentage of cases of middle-ear tuberculosis, the facial nerve is involved. A tubercular element in the pathogenesis of facial paralysis is recognized as affecting the prognosis unfavorably, from the greater frequency with which the nerve is actually destroyed. (7) Herpes zoster auriculæ (Hunt) is an occasional cause of facial paralysis. In this affection the morbid changes in the nerve are clearly an extension of the inflammatory process primarily affecting the geniculate ganglion.

Generally speaking, facial paralysis resulting directly from middle-ear or mastoid suppuration—the labyrinth having escaped infection—offers, under prompt and rational treatment, a perfectly favorable prognosis. Usually all that is required to effect a cure is careful removal of all diseased bone through a simple mastoidectomy or radical operation, according to the nature of the tympanic lesion.

Postoperative facial paralysis may occur (a) as the immediate result of division or injury of the nerve during a radical operation, or (b) as the deferred result of a slight traumatism, the paralysis appearing only after an interval of several hours or days has elapsed. (c) When the tympanic wall of the facial canal is either defective or unusually thin, paralysis may result directly from the pressure of a gauze dressing packed too tightly into the wound cavity. (d) A thick-walled, sclerotic mastoid with a very small, deeply-placed antrum is a type of bone in which during a simple mastoidectomy great care may be necessary to avoid injury to the nerve.

In this series there were 42 cases, some of which have already been reported by Persky.⁶² Of these the paralysis developed preoperatively in 24 and postoperatively in 18.

In the 24 cases in which palsy of the facial nerve developed prior to operation, the age incidence was from 6 years to 72, with an average of 39. There were 10 males and 14 females. In 13 cases the palsy was on the left side and in 11 on the right. In 14 cases it followed chronic infection of the ear, in 11, acute infection. The sense of taste was

⁶² Persky, A. H. Facial Palsy of Otic Origin, *Arch. Otolaryng.* **27**:395 (April) 1938.

recorded as tested in 12 cases. In these, 11 patients showed a loss of the sense of taste in the anterior two thirds of the ipsilateral half of the tongue, while in 1 the sense of taste was unimpaired. In the 24 cases 19 patients had operations. 7 had simple and 11 radical mastoidectomy and 1 only myringotomy. Five of the patients operated on showed cholesteatoma, and the rest showed acute or chronic mastoiditis. One of the patients operated on died of meningitis. 8 improved, and 10 showed no improvement. In 1 of the patients who did not improve labyrinthitis developed. Five patients were not operated on. Of these 4 showed some improvement and 1 is recorded as unimproved.

In 18 cases peripheral palsy of the facial nerve developed after an operation. The age incidence varied from 5 years to 58, with an average of 27. There were 7 males and 11 females. In 8 cases the palsy was on the left side and in 10 on the right. The sense of taste was tested in 9 of the 18 cases and was found to be lost in the ipsilateral anterior two thirds of the tongue in all 9. In 1 case, palsy followed immediately after myringotomy for acute otitis media, and the patient showed no improvement with subsequent treatment. In 4, it followed immediately after simple mastoidectomy for acute mastoiditis, and 3 of the patients showed no improvement, while 1 is considerably improved but has been receiving electrical treatment for the last ten years. Thirteen patients were operated on because of chronic infection, with or without acute exacerbation. All but 1 of these were subjected to radical mastoidectomy. Eleven of the 13 patients showed immediate paralysis, while in 2 paralysis developed within forty-eight hours after operation. Two of the 13 patients presented cholesteatoma at operation, 1 had labyrinthitis prior to operation, in 3 labyrinthitis developed after operation, in 1 an abscess of the temporal lobe developed, and in 2 encephalitis developed. Of the 13 patients, 1 died of an abscess of the temporal lobe, and the rest showed no substantial improvement.

On the basis of this study, I believe that when peripheral palsy of the facial nerve occurs in association with disease of the temporal bone an exploratory operation is indicated, unless it can be shown that the palsy is due solely to causes outside of the temporal bone. The advisability of a secondary operation in cases in which palsy of the facial nerve follows an operation must be determined by the otolaryngologist from his previous operative findings and the subsequent surgical developments.

Hunt's Syndrome. In this series there were 2 cases of Hunt's syndrome involving the facial nerve and presenting herpes on the soft palate, in the external auditory canal and over the auricle (Hunt⁶³).

63 Hunt, J. R. Genuiculate Neuralgia (Neuralgia of the Nevus Facialis) Further Contribution to the Sensory System of the Facial Nerve and Its Neuralgic Conditions, *Arch. Neurol. & Psychiat.* **37** 253 (Feb.) 1937.

SUMMARY AND CONCLUSIONS

This presentation contains a review of 326 cases in which neurologic complications arose from infections of the temporal bone and paranasal sinuses. Of these the complications were associated with disease of the temporal bone in 235 and with infection of the paranasal sinuses in 91. The 326 cases are classified and discussed from the standpoint of pathways of infection, clinical manifestations, diagnosis and treatment. Nineteen cases of special interest are reported in abstract form.

On the basis of a study of this material and some review of the literature, the following conclusions appear pertinent:

1. For a full appreciation of the neurologic complications arising from disease of the temporal bone and paranasal sinuses the neurologist, if he wishes to be of aid to the otorhinologist, must be conversant with the intricate anatomy of these structures and with its variations and anomalies. The temporal bone is no more a unitary structure than the brain is an equipotential organ. The neurologist moreover, must be familiar with the various pathways of infection leading to the neurologic complications.

2. It is important to remember that there may exist multiple etiologic factors, such as polysinusitis and simultaneous infection of the temporal bone and paranasal sinuses. The neurologic complications may arise on the side contralateral to the infected paranasal sinus. They may first become manifest after the infection of the temporal bone and paranasal sinuses disappears, and on the other hand, they may be present with "primary" mastoiditis, i. e., with an intact tympanic membrane or in the absence of any recent aural discharge.

3. For full orientation the clinician must bear in mind that the neurologic complications may arise from disease within the bone, as in peripheral palsy of the facial nerve or that the clinical manifestations may be due to processes in one or more of the following locations: the dura, the extradural and subdural spaces, the leptomeninges, the brain substance and the various intracranial venous channels. On the other hand, it is important to remember that infections in the temporal bone and paranasal sinuses may coexist with neurologic conditions resembling complications of otorhinogenic origin but due to causes entirely unrelated to these infections. Worthy of mentioning are meningococcic and tuberculous meningitis, meningeal irritations due to causes other than known bacteria, spontaneous subarachnoid hemorrhage, chronic subdural hematoma, tumor of the brain and visceral infections.

4. For accurate diagnosis the neurologist not only must make repeated complete neurologic examinations but also must always take

into account a number of factors. To start with, he must ascertain whether the process is acute, chronic or chronic with acute exacerbation. In addition to evaluating the symptoms and signs in their chronologic development, he must take into account the previous operative findings, the systemic reactions and the bacteriologic and other laboratory observations. Moreover, in formulating a diagnosis it is important to remember that, unlike many other neurologic conditions, these complications often run a rapid and changeable course.

5 Accurate anatomic diagnosis of neurologic complications arising from infection of the temporal bone or paranasal sinuses is difficult in a great many cases. The diagnosis of some conditions, such as extradural and subdural abscess, can be established only by exploration. The diagnosis of some neurologic complications, such as *early* meningitis, abscess of the brain and petrositis, is difficult because of the vagueness of the findings. In other cases the diagnosis is uncertain because of the difficulty in interpreting the existing symptoms and signs, which may be indicative of several different conditions. Thus, increased intracranial pressure as manifested by papilledema and increased intraspinal pressure may be due not only to abscess of the brain or severe meningitis but also to the more benign otitic hydrocephalus, arachnoiditis or nonsuppurative encephalitis. The same difficulty applies to the interpretation of some focal signs of disease of the brain. Thus, central palsy of the facial nerve, hemiparesis and even aphasia are encountered in such diverse conditions as abscess of the brain, extradural abscess and nonsuppurative encephalitis.

6 In making a diagnosis it is important to determine whether the complications in the cranial nerves are purely local, like the palsy of the abducens nerve of a Gradenigo syndrome, or a manifestation of a major intracranial complication, like the same palsy in the course of petrositis, abscess of the brain or beginning bacterial meningitis.

7 In the matter of treatment the neurologist has the responsibility of advising the removal of foci and the establishing of drainage, counseling lumbar puncture and other diagnostic procedures and suggesting chemotherapy and intracranial exploration.

8 The management of the neurologic complications of otorhinogenic origin requires the close cooperation of the otorhinologist, the ophthalmologist and the neurologist. The otorhinologist should consult with the ophthalmologist and the neurologist as soon as neurologic complications are suspected. Early and more accurate diagnosis will insure more effective treatment.

APPENDIX

REPORT OF NINETEEN CASES

CASE 1 (W T) —*Abscess of the right frontal lobe, first manifesting itself after recovery from sinusitis, ventriculogram, drainage and recovery*

In an 11 year old white boy, whose family history and past medical history were noncontributory, frontal headache and fever, with the temperature as high as 101 F, developed during the third week in June 1938. A diagnosis of acute sinusitis was made, and in a few days infraorbital and paranasal swelling and erythema developed on the right. On July 3, after an elevation of temperature to 103 F, the patient had a generalized tonic convulsion lasting ten minutes. Study in another hospital revealed no significant findings, and he was discharged after one week, in good condition. On July 11 headache and vomiting developed, necessitating readmission, at which time ophthalmoscopic examination revealed bilateral choking of the disks. The patient was transferred to the Graduate Hospital on July 25 with a subjective complaint that headache, vertigo and vomiting occurred when he was in the erect posture.

Objectively, on admission, the boy was found to be rather alert mentally. There was persistent bradycardia, the pulse rate ranging between 60 and 70 beats per minute. The temperature fluctuated between 98.4 and 100 F. The blood pressure was 94 systolic and 68 diastolic. The eyes presented bilateral catarrhal conjunctivitis, both nerve heads were swollen to 6 D with petechial hemorrhages. Visual acuity was 6/6 bilaterally, and the visual fields were normal. Barany examination suggested a supratentorial intracranial lesion on the right. There was no clinical evidence of either acute or chronic sinus disease. Roentgen examination of the skull on July 26 gave negative results, as did an examination of the paranasal sinuses. It was not until the films were reexamined at a time when a neurologic diagnosis had been established that the roentgenologist noted considerable haziness in the outline of the right frontal sinus, associated with thickening of the mucous membrane. These changes were thought indicative of inflammation of the right frontal sinus in which an infection had probably broken through the roof of the sinus. Early osteomyelitis could not be excluded.

The clinical impression of the staff was that of an expanding intracranial lesion, most likely a tumor, although one observer adhered to a diagnosis of abscess of the brain.

On September 1 a ventriculogram revealed "the presence of a large space-taking lesion in the right frontoparietal region, causing displacement of the ventricular structures of the left side and incomplete filling of the right anterior horn of the lateral ventricle." On the basis of such findings frontoparietal craniotomy was performed on the right with the patient under anesthesia induced by avertin with amylene hydrate. Because of suggested abscess of the brain, the dura was nicked, and the operative site was explored before wide exposure was attempted. A mass was felt 3.5 cm below the surface of the posterior portion of the right frontal lobe. Aspiration revealed yellow material suggestive of fluid from a tumor in Rathke's pouch. The dura was opened, the lesion outlined and a block of cortex 2 inches (5 cm) square removed from the top of the tumor. Reaspiration revealed 1 cc of thick pus, which on examination was found to contain gram-positive cocci.

The abscess defied enucleation because of (1) its thin capsule and (2) its firm attachment in the direction of the pituitary fossa. The dura over the lesion was

excised, and the edges overlying the lesion were sutured in position. A section of bone was removed and the bone flap wired in position. The abscess was packed with iodoform gauze and drained through a stab wound in the scalp. Three days postoperatively the abscess was opened and drained. It was removed in its entirety on the eighth postoperative day. Bacteriologic examination revealed hemolytic *Staphylococcus aureus* in pure culture. A pathologic report on the capsule stated: "The brain tissue bordering on the abscess is loose and more or less disintegrated. The cells are chiefly glial cells, lymph and plasma cells, with a collar of lymphoid cells about the capillaries. There are few polymorphonuclears. Elsewhere the brain is not so much involved. An area of hemorrhage is present."

Convalescence was, unfortunately, delayed because a small sponge had been left in the wound, which continued to drain cerebrospinal fluid. Reexamination of the eyegrounds on September 23 showed the bilateral papilledema diminished to 4 D, with visual acuity of 6/6 and normal fields. The patient was discharged to the family physician on September 8, with a well epithelializing wound, not completely closed but still draining small amounts of purulent material.

After his discharge from the hospital two draining sinuses appeared in the line of incision, and the patient was readmitted on November 7. A roentgenogram of the skull, November 8, disclosed "mottling along the superior margin of the flap of the right frontoparietal bone indicative of osteomyelitis."

On November 8, the scalp flap was reopened and the bone removed. Osteomyelitis was found to involve the medial border of flap just lateral to the longitudinal sinus. As the flap was removed, a previous opening into the ventricle was reestablished. This was covered with an alcohol sponge, from which ligatures were brought through the previous drainage opening. The patient's convalescence has been uneventful except for continued drainage from a slowly healing incision.

Comment—This case is important from several standpoints. Unlike others with abscess of the brain, the patient was mentally alert, presented an extreme degree of papilledema and appeared more like a patient with a rapidly expanding tumor of the posterior fossa of childhood without cerebellar signs than one with an abscess of the frontal lobe. The absence of any clinical or roentgen evidence of sinusitis would tend to strengthen the diagnosis of a tumor. However, the history of antecedent sinus disease and the Baily findings led to ventricular studies and cautious exploration for an abscess.

CASE 2 (A S)—*Fatal bacterial meningitis secondary to mastoiditis without nasal discharge, history of an old nasal infection*

In a boy 11 years of age, with an irrelevant family history and past medical history, vomiting with some abdominal pain developed in the early part of June 1930. At operation, a normal appendix and no cause for the vomiting were found. He was readmitted to the hospital on June 23, complaining of headache and vomiting. The temperature and pulse were normal. At this time a history was obtained of a discharge from the right ear some years previously. Examination revealed an old perforation of the right ear drum but no discharge. There was little tenderness over the mastoid, but roentgen examination revealed acute mastoiditis on the right side. In addition the patient showed bilateral choking of the optic disks. On June 27 he exhibited apathy, ptosis of the right upper eyelid, a rise in temperature, bradycardia and marked meningeal irritation. On June 27 a

simple mastoidectomy was done on the right side, which revealed acute mastoiditis. On June 29 he became stuporous and showed evidence of meningitis, a slow pulse and increased spinal fluid pressure, with 390 leukocytes. He succumbed to purulent meningitis on July 5.

Comment—This case illustrates the necessity of investigating the temporal bone in infectious processes of the nervous system of obscure causation. It is well known that intracranial infection may follow lesions of the middle ear without perforation of the drum and without mastoiditis.¹⁰ This case also calls attention to the significance of causeless vomiting, especially in childhood.

CASE 3 (K. G.)—Spontaneous subarachnoid hemorrhage first diagnosed as meningitis because of coexisting sinusitis, recovery

A 42 year old white married woman gave a past medical history which was irrelevant except that for two years she had had severe headaches, for which she had taken a variety of headache preparations. About two weeks prior to her admission to the Graduate Hospital, on April 23, 1935, she was taken with a queer feeling across the forehead, became dizzy and vomited, and immediately thereafter severe headache developed. For the following few days the pain was unbearable. She was treated for grip and sinusitis until admission to the hospital. When first seen, on April 26, she complained of a left-sided headache and pain in the back of her head. On the morning of April 26 she is said to have had a left-sided convulsive seizure.

Objective examination was reported as follows. The pulse, temperature and blood pressure were normal. The patient was dull and apathetic and complained of frontal and occipital headache, more marked on the left side. When she was aroused her mentality was clear but slow. She had photophobia, hyperesthesia, nuchal rigidity and bilateral Kernig and Brudzinski signs. She had definite weakness of the left external and the left superior rectus muscle, questionable weakness of the lower part of the right side of the face and marked exaggeration of tendon reflexes on both sides, with a right-sided Hoffmann and a left-sided Babinski sign and bilateral clonus with preservation of the abdominal reflexes. Sensation, as nearly as could be determined, was normal. The finger to nose test was carried out accurately, and the heel to knee test was not attempted. There was no astereognosis. The roentgenogram of the skull was normal. There was clinical and roentgen evidence of bilateral ethmoiditis. Routine studies of the urine and the blood gave negative results.

Lumbar puncture revealed high pressure and frankly bloody fluid. Special studies of the blood failed to disclose any dyscrasia.

The diagnosis of spontaneous subarachnoid hemorrhage was made. From then on treatment consisted of repeated lumbar punctures and the free use of codeine and acetylsalicylic acid for the relief of pain. The punctures gave marked relief. The spinal fluid continued to be bloody for about ten days, then it became yellow, and finally, almost clear. At the end of two weeks from the date of admission to the hospital there was little rigidity of the neck and slight manifestation of Kernig's sign. About May 7 paralysis of the right third nerve appeared, with ptosis and inability to move the eye inward, upward or downward. This persisted up to the discharge from the hospital, on May 22. In the succeeding few months the ocular palsy disappeared and the patient made a complete recovery. She still has occasional headaches.

Comment—With the history of sinus disease and the clinical symptoms that the patient presented, it seemed justifiable for the rhinologist to believe that this was a case of meningitis of sinus origin. It is probable that insufficient attention had been paid to the mode of onset of the acute symptoms and the presence of marked meningeal irritation with so little systemic reaction. This case emphasizes the value of spinal tapping in all cases of doubtful meningeal irritation.

CASE 4 (C H)—*Chronic subdural hematoma first diagnosed as abscess of the brain because of a history of sinusitis, operation and recovery*

A woman aged 21 was admitted to the Graduate Hospital on Aug. 26, 1938. The history was procured from the mother, as the patient was too dull mentally to cooperate. Except that she had had influenza in 1918, the past medical history was noncontributory. She had been married at the age of 18, separated for a year and divorced one year previously. For the past year she had been losing considerable weight. About three weeks prior to admission she had complained of pain in the left shoulder, which she attributed to a draft. The pain in the shoulder improved, but she felt indisposed until about ten days prior to admission, when she began to complain of pain in the left temple, left eye and left side of the face. A day or two later she noticed drooping of the left upper eyelid. The pain became more pronounced, and in addition she had nausea and vomiting. She was admitted to a hospital in one of the neighboring towns and was treated for sinus disease without any improvement. There was a history of chronic nasal discharge, but there had been no acute exacerbation of the nasal infection.

Objective examination on admission was summarized as follows. The pulse rate was 84, the temperature, normal. The patient was dull mentally. She had a tendency to fall asleep in the middle of a sentence. She responded sluggishly to questions and commands, perhaps because of medication. There was practically no rigidity of the neck and only a slight Kernig sign. There was questionable protrusion of the left eyeball. There was some tenderness to percussion of the skull, more marked on the left than on the right. In the course of the examination the patient was observed in attacks during which she complained of severe pain in the left temporal region and face. The fundi showed blurring of the nasal margins, more marked on the left than on the right. There was drooping of the left eyelid. The pupils were dilated, probably by a mydriatic. There was questionable weakness of the lower part of the right side of the face. Otherwise all the cranial nerves were essentially normal. The abdominal reflexes were not obtained. There was weakness of the right arm and leg but also some weakness of the left arm and leg. The entire musculature was flaccid. The tendon reflexes were depressed, more so on the right than on the left, and no Hoffmann or Babinski sign was manifested on either side. No neural tenderness was noted. No definite objective loss of sensation other than that which might be due to sluggish mentality was observed. The finger to nose and the heel to knee test were carried out poorly on the right side because of weakness.

Roentgen examination of the skull was difficult because the patient did not cooperate, but no gross abnormalities were noted. Examination showed mucosal thickening of the left maxillary and both ethmoid sinuses. The frontal sinuses appeared normal, and the sphenoid could not be visualized. Clinical examination revealed no evidence of active sinusitis. The Barany tests gave entirely negative results. Special studies of the eyes showed definite bilateral papilledema without

any significant changes in the visual fields. Routine studies of the blood and urine gave negative results. Spinal tapping was not attempted, because it had been performed in the hospital from which she was transferred. At that time the spinal fluid pressure, 350 mm of water, and the composition of the fluid showed no significant abnormality.

In the succeeding few days the patient's mentality and the power in the right arm and leg improved. However, the papilledema was getting greater, although the headache was diminishing. Accordingly, after a ventriculogram had been made, which showed the presence of a massive lesion in the left parietal region, craniotomy was performed, a chronic subdural hematoma was evacuated, and the patient made a satisfactory recovery. She was discharged on October 3.

When she recovered she gave a history to the effect that about four weeks prior to the onset of the headache she had received a beating from her former husband but had not considered it significant and had forgotten all about it before she became mentally dull.

Comment—The patient was sent in with a diagnosis of abscess of the brain due to sinusal disease. Clinically she exhibited signs of an abscess of the brain. However, it is well known that intracranial space-taking lesions, such as tumors or abscesses, may be simulated by chronic subdural hematoma. The latter condition is common, occurring as often without a history of cranial trauma as with such a history.

CASE 5 (R. B.)—*Cranio-pharyngioma associated with optic atrophy and severe sinusitis, operation on multiple sinuses, craniotomy, patient alive and blind*

A 30 year old laborer, with a noncontributory family history and past medical history, was admitted to the Graduate Hospital on Dec. 23, 1930, complaining of a throbbing frontal headache, loss of vision in the left eye and progressive loss of weight since August 1930.

Objective examination disclosed bilateral primary optic atrophy and bilateral inflammation of the ethmoid and sphenoid sinuses. In January 1931 submucous resection and bilateral sphenothmoidectomy disclosed greenish foul-smelling pus. The patient made a good surgical recovery but continued to have his symptoms. In the succeeding two years he continued to have the headache and became totally blind, marked hypopituitary changes developed, but no constant neurologic or roentgen abnormality appeared. The Barány tests repeatedly gave negative results. An encephalogram made on February 14 was normal.

The patient was next admitted to the Philadelphia General Hospital on July 26, 1932, when roentgen studies disclosed some deformation of the sella turcica, from which no definite conclusion could be drawn. An operation on the right side of the frontal bone on October 10 disclosed a suprasellar cystic tumor, part of which was extirpated. The patient made a good surgical recovery. He is still alive, but totally blind, and shows evidences of marked hypopituitarism. The pathologic diagnosis of the removed specimen was craniopharyngioma.

Comment—In this case a slowly expanding intracranial tumor was masked by the symptoms of associated sinusal disease. It is not at all unusual to encounter cases of visual disturbances due to pituitary or suprasellar tumor in which the patient is treated for sinusal disease.

CASE 6 (W B) — *Chronic otitis, labyrinthitis followed by thrombosis of the lateral sinus, subdural abscess in the posterior fossa and basal meningitis*

A dairyman, 51 years of age, was admitted to the Graduate Hospital on Sept 24, 1937. The family history was irrelevant. About Jan 1, 1936, the patient had been in an accident which rendered him unconscious for several hours, but he made a good recovery and was in good health until March 1937, when a discharge from the right ear, headache, dizziness and vomiting developed. He improved, but on August 25 he had a severe spell of vertigo with vomiting.

On admission to the hospital, on September 24, he complained of headache of several months' duration and of attacks of vertigo and vomiting by reason of which he had had to discontinue work six or seven weeks before. He stated that his headache was both occipital and frontal and that it was fairly constant.

The objective examination on admission disclosed the following facts. The patient was cooperative but was mentally dull. He was keenest when he complained about his headache. He had a slight elevation of temperature and a definitely slow pulse rate, about 60 per minute. There was slight rigidity of the neck but no Kernig sign. There was definite tenderness to percussion over the right frontotemporal region. The veins over this area were more distended than those on the left. The fundi showed blurring of the disks unaccompanied by any definite changes of the blood vessel ratio. The right palpebral fissure was definitely narrower than the left, the pupils were equal and responsive to light and accommodation. All extraocular movements were full, no nystagmus was observed. The fifth nerve was normal. There was suggestive central palsy of the left facial nerve on both volitional and emotional innervation. There was probably some impairment of hearing on the right. All the other cranial nerves were normal. The abdominal reflexes were not obtained. Station and gait were not tested. The patient had generalized weakness but no localized loss of motor function in any of the extremities. All tendon reflexes were symmetrically diminished, those of the knee and achilles tendon more so than those of the biceps and triceps. There was a definite Babinski reflex on the left side. All forms of sensation, including stereognosis, were accurately evaluated. The heel to knee tests were carried out accurately, as was also the finger to nose test on the left. The finger to nose test on the right was carried out inaccurately, while the pronation and supination test was carried out rather well on both sides.

The course in the hospital was as follows. From the outset the patient had a slow pulse and only a slight rise in temperature. A lumbar puncture on September 26 revealed a pressure of 150 mm of water and 197 cells, with 43 polymorphonuclears, the leukocyte count was 11,200, with 67 per cent polymorphonuclears. The other laboratory studies gave negative results. Roentgen examination of the sinuses revealed haziness in both frontal and both ethmoid sinuses, that of the right mastoid indicated an infection in early infancy but no active disease, that of the skull gave negative results and that of the chest showed an old inactive tuberculous lesion in the apex of the left lung.

On September 28 radical mastoidectomy was performed on the right side. The lateral sinuses and the posterior fossa were exposed without finding any evidence of an active pathologic process. Puncture on October 8 showed a pressure of 310 mm of water. On the same day trephination above the right squamous region disclosed no evidence of an abscess of the middle fossa. A second trephination, over the right cerebellar hemisphere, revealed a subdural abscess. The patient died on October 12. The autopsy showed a subdural abscess of the posterior fossa, basal meningitis and thrombosis and suppuration of the lateral sinus.

Comment—In this case not sufficient attention had been paid to the history of labyrinthine symptoms, and consequently the operative exploration was not sufficiently concentrated on the posterior fossa early in the process. Probably an early and complete exploration of the lateral sinus and the posterior fossa might have altered the course.

CASE 7 (P S)—*Severe delirium associated with and following severe sinusitis, subacute pulmonary and multiple renal abscesses revealed at autopsy*

A 58 year old salesman, with an irrelevant family history and past medical history, was admitted to the Graduate Hospital on Aug 8, 1938, with his chief complaints loss of weight, headache and a profuse nasal discharge. His difficulties had begun about ten weeks previously, with rhinitis, which became purulent and was diagnosed as malignant disease of the sinuses.

On admission to the hospital his condition was toxic, and he had an elevation of temperature and pulse rate and low grade bilateral polysinusitis. A biopsy, however, revealed only inflammatory tissue and no malignancy.

In spite of local treatment, the patient continued to be in a toxic state, febrile and delirious. After preliminary transfusions the middle turbinate bone was removed, and good drainage was established for all the sinuses. Within two weeks after this procedure the nasal discharge stopped and the temperature returned to normal, but the patient remained somewhat delirious. At this time and for the succeeding ten days repeated physical and neurologic examinations gave entirely negative results. In spite of this he began to have a marked septic temperature without chills, progressive loss of weight and progressively more marked delirium. Repeated blood counts showed only moderate leukocytosis and secondary anemia. Chemical studies of the blood, as well as repeated urinalyses, gave negative results. On September 24 roentgen examination of the chest showed a lesion suggestive of a pulmonary tumor or abscess. On physical examination this lesion appeared to be inactive. A lumbar puncture on the same date showed no increase in pressure and no abnormality of the fluid.

The patient died on October 1. The autopsy of the skull, including the temporal bone, the sinuses and the intracranial contents, showed no abnormality. There was a subacute abscess in the middle lobe of the right lung. There were numerous small abscesses in the substance of both kidneys. These abscesses did not communicate with the renal pelvis.

Comment—In this case it was difficult to convince ourselves that the delirium was not due to some obscure intracranial complication of sinus origin. It is of rare interest that there was so little laboratory evidence of such extensive pathologic change in the kidneys, which was responsible for death.

CASE 8 (J C T)—*Extradural abscess associated with papilledema, oculomotor involvement and implication of the abducens nerve, acute mastoiditis, operation and recovery*

A 25 year old farmer was admitted to the Graduate Hospital on July 11, 1929, with the chief complaint recurrent headaches. The family history and past medical history were irrelevant. Following an infection of the upper part of the respiratory tract in January 1929 a discharge had developed in the left ear, and in February he had transient pain in the right ear. The left ear had been

discharging since January. On July 1 pain had suddenly developed in the right temporal region and the right eye and had remained constant and severe. Since July 5 the patient had had diplopia.

Objective examination on admission disclosed a normal temperature and pulse, a discharge from the left ear, some tenderness over the right mastoid, bilateral papilledema (right, $3\frac{1}{2}$ D, left, $2\frac{1}{2}$ D), normal visual fields, slight ptosis of the right upper eyelid, weakness of both external recti, more marked on the right, and tremors of the fingers when extended. Roentgen findings were subacute purulent mastoiditis on the left, acute purulent mastoiditis on the right and clouding of the right frontal and both anterior ethmoid sinuses and of the right maxillary antrum. Routine laboratory studies gave negative results.

On July 15, radical mastoidectomy was performed on the right. The exploration disclosed acute mastoiditis, with an extradural and perisinus abscess and a thickened nonpulsating dura. From then on the headache disappeared, the choking of the optic disks and the other neurologic abnormalities gradually receded, and the patient was discharged on August 4 in good condition. He has since remained well.

Comment—In this case evidences of increased intracranial pressure due to an extradural abscess were presented. In some respects the clinical picture resembled that of otitic hydrocephalus (to be described later), which however usually follows mastoidectomy and is unassociated with an active infected focus requiring surgical eradication.

CASE 9 (B S)—*Chronic otitis with acute exacerbation, mastoidectomy followed by peripheral palsy of the facial nerve and severe protective meningitis, reoperation and findings of dural fistula, use of sulfanilamide, recovery*

In an unmarried 25 year old teacher, otitis media of two weeks' duration had developed on the right seven years previously. About Nov 1, 1936, pain in the right ear and a few days later a discharge from the right ear had developed. She was admitted to the Northern Liberties Hospital on December 15 with acute mastoiditis and pain radiating to the middle and lower part of the right side of the face. Simple mastoidectomy was performed on the day of admission. This was followed by fever for two days and then by an afebrile, symptomless period for about ten days. On December 21 incomplete peripheral palsy of the right facial nerve developed, with some nystagmus. On Jan 3, 1937, chills, fever, sweats, general malaise, headache, vomiting and occasional slowness of the pulse developed. About January 4 the patient complained of stiffness of the neck.

Examination on January 4 revealed a lucid patient with slight but definite rigidity in the neck and incomplete peripheral palsy of the right facial nerve. The rest of the observations on neurologic examination were negative. The spinal fluid was under considerably increased pressure and showed close to 800 cells, mostly polymorphonuclears. Organisms were not found on smear or culture.

On January 8, the mastoid incision was revised, and a fistula tract filled with granulation was found over the dura of the middle fossa. The smears from the mastoid pus showed a hemolytic streptococcus. For the succeeding two weeks the patient had a septic temperature, with marked meningeal signs, high spinal fluid pressure and varying pleocytosis. Recovery was appreciably hastened by the use of sulfanilamide, and the patient was discharged in good condition on February 7.

Comment—This is a case of severe protective meningitis in which, at operation, localized pachymeningitis, both internal and external, was observed. The removal of the infected focus with the establishment of free drainage, as well as the use of sulfanilamide, probably prevented bacterial meningitis.

CASE 10 (M. B.)—Abscess of the left frontal lobe developing four months after acute ethmoiditis on the right, abscess lateralized by central palsy of the right facial nerve and pineal shift to the right, multiple operations, patient still alive

A youth of 17, a mechanic, was admitted to the Graduate Hospital on Jan. 10, 1938. The family history and past medical history were irrelevant. In August 1937 the patient had had ethmoiditis on the right, which necessitated an intranasal operation. He was discharged in two weeks but did not return to work because of general weakness. One month before admission he began to have severe frontal headaches and diplopia on looking to the left. The headaches became worse in severity and duration. One week before admission he had nausea and vomiting and these symptoms again appeared on the day of admission. He became weak and progressively drowsy. The headache was most marked over the left side of the forehead.

Examination on January 10 revealed a weak and drowsy boy complaining of violent headache. The temperature was 99.8 F, the pulse rate 54 and the respiratory rate 24. There was no disorientation or confusion. The fundi showed papilledema (right, 2 D, left, 3 D). There were no defects of the field of vision. There was slight weakness of the right lateral rectus muscle and slight but definite central palsy of the right facial nerve. The rest of the observations on neurologic examination were negative. Roentgen examination of the skull demonstrated a pineal shift to the right. Roentgen and clinical examination of the sinuses showed slight mucosal thickening and no other significant abnormality.

On the basis of these findings a diagnosis of abscess of the left frontal lobe of the brain was made. The patient was operated on on January 11, when preliminary probing revealed resistance, possibly of a capsule, in the left frontal lobe. On January 12 operation revealed pus in the left frontal lobe, into which a drain was inserted. During the postoperative period the patient showed witzelsucht. On January 22 the spinal fluid pressure was 420 mm of water. Increasing intracranial pressure necessitated subtemporal decompression on the right on January 24. Improvement was gradual, and the patient was discharged apparently well on February 26. A follow-up on March 4 revealed no abnormality.

He was readmitted on April 15, because of a return of headache and vomiting. The temperature was 102.4 F and the pulse rate 100. No neurologic abnormality was noted at that time. On the basis of the previous history a recurrence of the abscess of the brain was suspected. A roentgenogram of the skull, made on April 18, revealed a marked pineal shift to the right. A drain was again inserted into the abscess cavity, and drainage of pus was established. A stormy convalescence ensued, during which right hemiplegia appeared and disappeared. The patient was discharged, much improved, on June 28.

On September 5, he again returned to the hospital, complaining of headache, fever and malaise. The temperature was 101 F and the pulse rate 96. There was neurologic evidence of mild meningeal irritation. Drainage from the abscess was

again established, and the patient was discharged in good condition on November 6. The pineal body, at this admission, was but slightly shifted to the right.

Comment—In this case the original sinal infection was on the right side and cleared up, while the abscess of the brain developed on the left in the absence of any active sinal process. This case also emphasizes the diagnostic value of central palsy of the facial nerve and of routine roentgen studies of the skull, as the pineal shift determined the lateralization of the lesion.

CASE 11 (B. G.)—*Nonsuppurative encephalitis, acute otitis on the left, bradycardia, right hemiparesis and aphasia, intracranial exploration with negative results, recovery following mastoidectomy.*

A 13 year old girl, with a noncontributory family history and past medical history, was admitted to the Graduate Hospital on Jan. 28, 1933, with right hemiplegia and aphasia. Two weeks prior to admission infection of the upper part of the respiratory tract had developed, with pain in the left ear and, several days later, cervical adenitis. A week prior to admission aphasia and some weakness of the right side of the body developed.

Objective examination on admission disclosed a rather ill child, with a slight rise in temperature, a pulse rate of 64, a perforation in the left ear drum, some clinical and roentgen evidence of acute mastoiditis, cervical adenitis, bilateral papilledema ($2\frac{1}{2}$ D) with no defects in the visual fields, mixed aphasia and right hemiparesis. Routine laboratory studies showed 10,950 leukocytes and no other significant abnormality.

On January 29 right-sided jacksonian convulsions developed, which lasted fifteen minutes. On the same day the motor cortex was exposed. The dura was darker than normal but pulsated normally, and the cerebrospinal fluid was increased and clear. Exploration for an abscess gave negative results.

On January 30 simple mastoidectomy was performed. Acute suppurative mastoiditis was found at operation. The dura was not exposed.

From the time of the simple mastoidectomy, the patient made slow but steady improvement. At the time of her discharge from the hospital, on March 14, the aphasia, right hemiparesis and choking of the optic disks had completely disappeared.

Comment—In this case almost classic findings of an abscess of the left temporosphenoid lobe occurred, and the final diagnosis was made by operative procedures and the course of the case. In retrospect it appears that it would have been better to perform the mastoidectomy before attempting cerebral exploration.

CASE 12 (E. K.)—*Nonsuppurative encephalitis, chronic mastoiditis on the left, radical mastoidectomy, labyrinthitis and a second radical mastoidectomy, recurrence of labyrinthitis, Hunsberg operation, palsy of the facial nerve and aphasia, recovery without subsequent operation.*

A woman aged 38 was first admitted to the Graduate Hospital on Sept. 26, 1930, and on September 27 had radical mastoidectomy on the left for a chronic discharge from the ear. The ear continued to discharge, and in addition pain in back of the neck developed. A revision of operative wound on June 2, 1931, gave no relief, and an injection into the occipital nerves in December 1932 relieved the

pain The patient was readmitted on Oct 29, 1934, with acute labyrinthitis and had a second radical mastoidectomy on October 29 She was readmitted on Jan 5, 1936, with symptoms of labyrinthitis On January 6 she had a Hinsberg operation The horizontal and semicircular canals and the vestibule were opened This procedure was followed by complete paralysis of the facial nerve and marked labyrinthine symptoms In addition aphasia developed, which lasted about ten days The patient was discharged on January 26, with paralysis of the facial nerve but only a few labyrinthine symptoms Studies of the spinal fluid are not recorded Follow-up reports indicate no other complications

Comment—The transient aphasia without subsequent development of an abscess of the brain indicates that the patient had *localized encephalitis* The marked labyrinthine involvement would tend to implicate the posterior fossa Yet the aphasia shows that the infection extended upward or forward into the middle fossa

CASE 13 (A B)—*Localized nonsuppurative meningoencephalitis due to acute exacerbation of chronic sinusitis, recovery*

A man 28 years old, a clerk, was admitted to the Graduate Hospital on April 9, 1938 The family history and past medical history were irrelevant except that he had had chronic sinusitis, with an intranasal operation, some years previously About a month prior to admission acute sinusitis had developed, which improved with treatment No history of any other recent infection or cranial trauma was elicited For about ten days prior to admission the patient had had recurrent headaches On April 12 at 11 30 a m he complained of severe frontotemporal headache on the right and considerable twitching of the left side of the face He then lost consciousness for fifteen to twenty minutes and on regaining consciousness vomited and complained of severe headache An examination at his home on April 9, 1938, showed a temperature of 100 F, a pulse rate of 88 and normal blood pressure He was apprehensive but mentally clear There was a slight elevation of the disk on the left side, central palsy of the left facial nerve, some impairment of the sense of position and marked astereognosis of the left hand He had no evidences of meningeal irritation

Throughout his residence in the hospital the temperature was normal except for a slight elevation on April 11 The pulse rate varied between 60 and 90, and the respiratory rate was regular and normal The routine blood count and the chemical composition of the blood were normal Studies of the spinal fluid were reported as follows April 9, 1938, 300 mm of pressure, 150 cells, predominantly lymphocytes, April 14, 1938, 260 mm of pressure, 17 lymphocytes, 125 mg of protein, April 19, 1938, 120 mm of pressure, no cells, 50 mg of protein, April 21, 1938, 140 mm of pressure, 6 lymphocytes, 40 mg of protein Other studies of various specimens of spinal fluid gave negative results Several Barany tests disclosed no significant abnormality Repeated studies of the eye showed no diminution in acuity, essentially normal fields and slight elevation of the disks for only several days after admission to the hospital Roentgen study of the skull gave negative results, that of the sinuses showed some involvement of the left frontal, the ethmoid and both maxillary sinuses No evidence of osteomyelitis was found

Within two days after admission to the hospital the sensory changes disappeared, but the central palsy of the left facial nerve persisted The headache decreased with repeated lumbar punctures and local nasal treatment When dis-

charged, on April 23, the patient still had some pain in the head and slight central palsy of the facial nerve. He has remained well.

Comment—This is a case of localized nonsuppurative meningo-encephalitis due to sinus disease. The subsidence of the focal signs of involvement of the brain and of the meningitis prevented a cerebral exploration to which there was a strong temptation. Moreover, the patient had sinusitis on the left side with encephalitis on the right, illustrating how the cerebrum may be involved from disease of the sinuses on the opposite side.

CASE 14 (L. B.)—*Diffuse nonsuppurative encephalitis due to sinusitis, recovery*

A boy aged 15 was admitted to Graduate Hospital on Nov. 30, 1935. The family history was irrelevant. The patient had had scarlet fever at 6 years and osteomyelitis of the left tibia at 9 years. His present illness had begun on Nov. 27, 1935, with coryza and generalized weakness. Within a few hours a temperature of 102° F. developed, and he became drowsy. He remained semistuporous, at times, however, becoming noisy and boisterous. On his admission to the hospital the temperature was 100° F. and the pulse rate 80; he was stuporous but could be aroused, when he became unruly and profane. Neurologic examination showed no abnormality except for marked depression of all tendon reflexes and failure of convergence. The nose was markedly congested, but the sinuses were draining well. Lumbar puncture showed a pressure of 170 mm. of water, the fluid was clear and yielded the following data: cell count 12, sugar content 55, chloride content 660, Wassermann reaction negative. A blood count showed leukopenia (3,600 cells). Roentgen examination of the sinuses showed clouding of the left maxillary sinus, which had the appearance of acute sinusitis. In the succeeding few days the patient became brighter but showed persistence of leukopenia and generalized adenopathy. Three days later erythema developed. From then on his general condition improved, and he was discharged from the hospital in good condition on December 15.

Comment—This was a case of low grade diffuse encephalitis associated with mild infection of the upper part of the respiratory tract and sinusitis. It is of interest that this mild infection may give rise to intracranial complications. The pathway of infection in this case was probably through the cerebrospinal fluid and the general circulation.

CASE 15 (W. L.)—*Diffuse meningoencephalitis with involvement of multiple cranial nerves, due to minimal sinusitis, recovery*

A laborer aged 21 was admitted to the Graduate Hospital on April 19, 1932. The family history and past medical history were irrelevant. The onset was two weeks previous to admission with infection of the upper part of the respiratory tract, including sore throat. Five days later fever and malaise appeared. A week prior to admission severe frontal headache and two days prior to admission inability to close the left eye developed.

On his admission to the hospital the temperature was 99° F., with a labile pulse rate, varying between 80 and 120. Otorhinolaryngologic examination showed congestion of Shrapnell's membrane and of the mucous membrane of the nose,

with a mucopurulent discharge on both sides in the region of the middle turbinate, more marked on the left side. The rest of the observations on somatic examination were negative.

Neurologic examination showed a dull and drowsy patient, who could be readily aroused, when he answered questions promptly and accurately. Evidence of meningeal irritation or tenderness over the nerve trunks or muscles was not noted. The patient presented bilateral iritis and papillitis, bilateral ptosis, weakness of both external rectus muscles, hypalgesia of both corneas, peripheral palsy of the left facial nerve and depression of all tendon reflexes. Roentgen examination of the sinuses gave essentially negative results, as did the blood count and other routine blood studies.

On April 21 the patient showed definite paralysis of both superior rectus muscles and a slight Kernig sign. On April 25 nausea and vomiting developed, with evidences of obstruction in the upper part of the gastrointestinal tract. Clinical and roentgen studies of the gastrointestinal tract led to the diagnosis of obstruction high in the small intestinal tract, possibly due to ileus, adhesions or enlarged nodes in the root of the mesentery. Examination at this point revealed a low chloride content of the blood, and the administration of physiologic solution of sodium chloride relieved the nausea and vomiting markedly. On April 27 lumbar puncture showed a pressure of 160 mm of water. The fluid contained 23 lymphocytes, and the colloidal gold curve was 0011100000. On April 30 the patient showed definite improvement in the condition of the cranio-orbital nerves, but difficulty in swallowing and numbness in the right arm developed. In the succeeding few days he improved rapidly and when discharged on May 11 showed only residual symptoms, palsy of the facial nerve and involvement of the superior rectus muscle, which subsequently cleared up completely.

Comment—This was a case of severe meningoencephalitis which followed infection of the upper part of the respiratory tract with minimal sinusitis. The condition probably originated from a virus, and the pathway of infection was probably the systemic circulation, for had it been retrograde thrombophlebitis the condition would not have had such wide distribution or recovery been so rapid. The vomiting was undoubtedly associated with disturbance of the central nervous system at the outset but continued later because of alkalosis, emphasizing the importance of disturbances in the chemical composition of the blood in neurologic practice.

CASE 16 (H. B.)—*Adhesive arachnoiditis, attacks of headache, projectile vomiting and papilledema over ten years, adhesions about the optic chiasm disclosed by craniotomy, recovery*

In a 40 year old tailor, with a noncontributory family history and a history of repeated colds, severe headache and vomiting developed in 1926. He was admitted to a hospital, where the studies revealed only bilateral papilledema. In the course of a few months he made a good recovery. In the latter part of May 1932 he was taken with severe headache, vomiting, dizziness, occasional horizontal diplopia, general weakness and occasional uncinat fits. When examined on June 10 he showed bilateral papilledema and central palsy and hyperesthesia on the right side. He recovered from this acute episode but continued to have some headache and dizziness and in addition complained of some impairment of

vision and memory The objective findings on September 20 were the same as on June 10 On Feb 10, 1933, he complained only of slight headache and slight visual disturbances, and the results of neurologic examination remained unchanged On Jan 6, 1934, he complained of headache on the left side and considerable impairment in sight and exhibited bilateral papilledema, central palsy of the right facial nerve and increased reflexes on the right The Barany tests at this time gave negative results The acuity of vision on January 13 was 6/12 in the right eye and 6/60 in the left eye, and he showed bilateral papilledema Roentgen examination on January 22 showed deformity of the sella turcica, consisting chiefly of an increase in size (anterior pituitary measurement, 16 mm, depth, 9 mm) There appeared to be some erosion of the anterior clinoid processes These roentgen findings suggested the possibility of an intracranial lesion, probably in the anterior cranial fossa A careful study of the sinuses disclosed no significant abnormality The patient continued to have recurrent headache and dizziness, with progressive loss of vision in both eyes Roentgen studies on Sept 9, 1936, showed further increase in the sella and, in addition, erosion of the top of the dorsum sellae The picture suggested a suprasellar tumor

On October 3, at the Graduate Hospital, after an encephalogram had been made, transfrontal craniotomy on the right disclosed arachnoiditis in the suprasellar region and adhesions about the optic nerves and chiasm The adhesions were freed The patient made a good surgical recovery despite postoperative pleurisy A note made on Sept 10, 1938, stated The patient had no subjective complaints The disks and the visual fields were grossly normal

Comment—This case falls definitely into the group of cases of arachnoiditis producing symptoms strongly suggestive of tumor of the brain The long duration and periods of remission are of considerable interest It must be assumed that the arachnoiditis was associated with periods of interference with the circulation of the cerebrospinal fluid corresponding to the episodes of marked symptoms of increased intracranial pressure

CASE 17 (E L) —*Otitic hydrocephalus, acute otitis and mastoiditis, with simple mastoidectomy, thrombosis of the lateral sinus, with ligation, headache, vomiting and papilledema, recovery with lumbar punctures*

In a girl aged 8 years, with an irrelevant family history and past medical history, otitis and mastoiditis developed on the right side in February 1936, with incomplete palsy of the facial nerve, for which she had simple mastoidectomy at the Northern Liberties Hospital This was followed by cervical adenitis and thrombosis of the lateral sinus, for which the right jugular vein was ligated She had a rather stormy convalescence and was doing well, when, late in May 1936, headaches, vomiting and some difficulty with vision developed

On admission to the Graduate Hospital on June 19 she had $4\frac{1}{2}$ D of choking of the optic disks on the right and $3\frac{1}{2}$ on the left, horizontal and vertical nystagmus and no other clinical neurologic abnormality The first spinal tap showed a pressure of 240 mm of water, the fluid contained 11 lymphocytes and was normal in other details Urinalysis, blood counts, chemical study of the blood and roentgen examination of the skull gave negative results

The papilledema began to recede after the first spinal tap Three additional taps were performed, the pressure gradually receding to 140 mm of water There was only occasional headache and no vomiting The patient was discharged

from the hospital on July 16 with only slight elevation of the disks. Follow-up reports indicated complete recovery.

Comment—This was probably a case of the type of condition described by Symonds as otitic hydrocephalus. While it is true that papilledema sometimes follows ligation of the jugular vein, there is usually not such a high degree of choking of the optic disks, and accompanying neurologic abnormalities are not seen.

CASE 18 (A McC)—*Otitic hydrocephalus, acute otitis and mastoiditis, with simple mastoidectomy, headache and papilledema recovery after reoperation and removal of diseased bone*

A woman aged 34 was admitted to the Graduate Hospital on April 21, 1933. The family history and past medical history were irrelevant. About four weeks prior to admission acute otitis and mastoiditis had developed on the left, for which she had had simple mastoidectomy. Since the operation, she had had generalized headache, more marked on the left side. A spinal tap performed prior to admission to the Graduate Hospital showed considerable elevation in spinal fluid pressure. The fluid contained 3 lymphocytes and was otherwise normal.

Physical and neurologic examinations showed no abnormality except for elevation of the disks of less than 2 D. Vestibular tests indicated hyperactivity of the left labyrinth. Routine blood studies gave negative results. Roentgen examinations revealed a suppurative process around the sinus, proximal to the knee on the left side.

On April 28 the mastoidectomy wound on the left was reopened and the cells cleaned out. Recovery was uneventful and when discharged, on May 9, the patient was free from pain, and the disks were receding. Follow-up reports indicated that she made a complete recovery.

Comment—This case emphasizes the importance of eradicating the foci of infection in cases of otitic hydrocephalus.

CASE 19 (A K)—*Chronic otitis on the right, with acute exacerbation, radical mastoidectomy on the right, followed by thrombosis of the left cavernous sinus, which at autopsy was shown to be due to disease of the left temporal bone*

A woman aged 37, with an irrelevant family history, who had had pneumonia on three occasions and was subject to frequent colds, was admitted to the Harrisburg Hospital on Sept. 13, 1938, complaining of pain in the right ear. The hearing in the right ear had been poor for years. On Aug. 1, 1938, pain in the right ear and fever had developed, but no aural discharge. She had been bedridden from August 24 to the time of admission to the hospital.

Objectively, on admission she was malnourished, with a temperature of 101, a pulse rate of 110, a respiratory rate of 20 and a blood pressure of 110 systolic and 70 diastolic. Mentally the patient was lucid. Neurologic examination gave negative results. There was tenderness over the right mastoid. Roentgenograms revealed necrosis in the anterior superior portion of the right mastoid, directly above the external auditory meatus. The left mastoid appeared normal. There were leukocytosis (14,550 leukocytes, with 57 per cent polymorphonuclear cells), secondary anemia and some albuminuria.

On the day of admission radical mastoidectomy was performed. Suppuration engrafted on an old cholesteoma, with granulations over the sigmoid sinus, was the chief finding. The dura of the middle fossa was exposed and found normal.

The patient's condition was good for two days, and then she gradually became dull and later semistuporous. On September 19 there was some rigidity of the neck, the right pupil was larger than the left and the reflexes of the left knee and achilles tendon were increased over those of the right. The spinal fluid pressure was normal, and there were 4 cells. On September 20 proptosis of the left eye appeared, and there was engorgement of the retinal vessels in both eyes. On September 21 there was marked proptosis of the left eye, with marked edema with prolapse of the conjunctiva and immobility of the eyeball. The spinal fluid pressure was 21 mm of mercury, but the fluid findings were negative. The temperature and pulse rate gradually increased, and the respirations became irregular. The patient died on September 23.

The autopsy showed the right middle fossa filled with yellow-greenish pus. A large subdural abscess in the right middle fossa was compressing the lateral portions of the frontal, the temporal and the occipital lobe. The lateral and the cavernous sinus on the left contained a large amount of creamy pus. There were suppuration and necrosis of the petrous portion of the left temporal bone.

Comment—This case by itself illustrates many of the difficulties and tragedies of neurologic complications of disease of the temporal bone. Ten days prior to the patient's death a thorough exploration failed to disclose any beginning of a subdural abscess. Two days prior to her death the spinal fluid showed no evidences of purulent meningitis. The cause of the thrombosis of the cavernous sinus on the opposite side, due to extensive disease of the temporal bone on the left side, was not even suspected until the autopsy was performed.

THE LARYNX IN INFANTILE BERIBERI

VIVENCIO C ALCANTARA M D

AND

GEMINIANO DE OCAMPO, M D

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Infantile beriberi remains a major medical problem in the Philippine Islands. Its yearly toll of infant lives is enormous, challenging the imagination and demanding the cooperative effort of every physician in the country. In 1928, according to Professor Albert,¹ the foremost worker on the subject today in the country, "the Philippine Committee on Beriberi"² stated that infantile beriberi claimed an average of 16 500 deaths annually among infants alone, representing 28.10 per cent of the total deaths among infants under 1 year of age. It is still in the shadow of half knowledge. Albert stated in one of his articles, "I wish to encourage the interest of other workers, particularly clinical towards this question still mysterious in its appearance, diagnosis and treatment."

The present work has been actuated by a desire to contribute if only in a small measure, to the clinical study of infantile beriberi. The department of pediatrics of the Philippine General Hospital has given us wholehearted cooperation, not only in supplying us with cases but also in giving us valuable suggestions in this clinical investigation of a phase of infantile beriberi in which the pediatrician and the laryngologist are mutually interested. Our main problem is this: Could something of clinical value, diagnostic or otherwise be gained by the examination of the larynx in infantile beriberi? Is it worth while for the pediatrician to have the larynx examined in every case of hoarseness in children?³

Hoarseness and weakness of the voice, sometimes aphonia, are among the most frequent symptoms of infantile beriberi. "It is a clinical fact

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1 Albert, J. Studies on Five Hundred Fourteen Cases of Infantile Beriberi, *Philippine J. Sc.* **45** 297 (June) 1931

2 Lopez Rizal, L. Report of the Committee on Beriberi, *J. Philippine Islands M. A.* **8**:422 (Oct) 1928 cited by Albert¹

3 Alcantara, V. C., and de Ocampo, G. Bronchoscopy-Minded. *J. Philippine Islands M. A.* **17**:465 (Aug) 1937

according to Albert,⁴ "that the aphonic form constitutes from 80 to 90 per cent of all cases of infantile beriberi." Not only is aphonia the most frequent symptom, but it is the one that stays to the last.⁵ Albert⁴ stated "So long as the voice has not recovered its normal pitch, the infant is constantly threatened by an acute attack which may terminate in death in a few hours." Yet, in spite of the significance of this symptom, the condition of the larynx in infantile beriberi has been studied meagerly abroad and never before in this country. Textbooks⁶ on laryngology do not mention it. Fernando⁷ in 1924 reported 2 cases of adult beriberi in which the left vocal cord was completely paralyzed, but he made this statement "among infants in whom hoarseness and aphonia have been more constantly observed, I have not attempted any laryngoscopic examination to determine the lesion in the larynx, especially in the cords." Albert¹ stated "It should be noted that so long as we consider this disease as adult beriberi in miniature, we shall be committing a gross mistake. Infantile beriberi differs from adult beriberi in almost every particular, pathological, clinical, and therapeutical." However, de Langen and Lichtenstein^{5b} maintained that the pathologic changes in infantile beriberi are the same as those in adult beriberi. Haridas,⁸ in his report of 102 cases of infantile beriberi observed in Singapore, British Malaya, stated "Direct laryngoscopy performed on a series of cases by Mr B. M. Johns, Surgeon and Otorhinolaryngologist at the General Hospital revealed that there was edema round about the arytenoids." According to Katsujū Kato,⁹ "Kubo first demonstrated by laryngoscopic examination that this symptom [aphonia] was due to the paralysis of the left recurrent laryngeal nerve. The vocal band often shows a disturbed abduction and a later fixation." It is therefore evident

4 Albert, J. The Treatment of Infantile Beriberi with the Extract of Tiqui-Tiqui, Philippine J. Sc. (Sect. B) **10** 81 (Jan.) 1915.

5 (a) Chamberlain, W. P., and Vedder, E. B. The Care of Infantile Beriberi by the Administration to the Infant of an Extract of Rice Polishing and the Bearing Thereof on the Etiology of Beriberi, Bull. Manila M. Soc. **6** 26, 1912. (b) de Langen, C. D., and Lichtenstein, A. A Clinical Text-Book of Tropical Medicine, translated by A. H. Hamilton, Batavia, G. Kolff & Co., 1936. (c) Albert⁴.

6 (a) Jackson, C., and Jackson, C. L. The Larynx and Its Diseases, Philadelphia, W. B. Saunders Company, 1937. (b) Jackson, C., and Coates, G. M. The Nose, Throat and Ear and Their Diseases, *ibid.*, 1929. (c) Thompson, St. C., and Negus, V. E. Diseases of the Nose and Throat, New York, D. Appleton-Century Company, 1937.

7 Fernando, A. S. Laryngeal Symptoms in Beriberi, Philippine J. Sc. **24** 41 (Jan.) 1924.

8 Haridas, G. Infantile Beriberi, J. Malaya Br. Brit. M. A. **1** 26 (June) 1937.

9 Kato, K. Beriberi in Infancy and Childhood, in Brennemann, J. Practice of Pediatrics, Hagerstown, Md., W. F. Prior Company, Inc., 1937.

that there is confusion and insufficient observation of the laryngeal lesions in infantile beriberi, as found by these Japanese and English workers

CLINICAL OBSERVATIONS

Our present clinical investigation covers over two years, and our material includes 37 cases of infantile beriberi. For control we have observed 31 cases of hoarseness from other causes in children. All of the 68 patients were admitted to the department of pediatrics of the Philippine General Hospital. We submitted all of them to direct laryngoscopic examination without anesthesia. Usually the only preparation was to give nothing by mouth for at least six hours before the laryngeal examination. With training, there should be no difficulty in examining the larynx of even the youngest infant. Jackson and Jackson^{6a} stated in this connection

The larynx of any human being whose mouth can be opened, of any age from the newborn to the person dying of senility, can be examined. No man worthy of the name of laryngologist should commit himself to a diagnosis without such an examination.

In only 1 case in the control group, was the examination not thorough, because of the spasm of the glottis on insertion of the laryngoscope, causing signs of asphyxia.

The examination takes only from a few seconds to a few minutes. It must be done gently and fast but not so hurriedly as to preclude a thorough and accurate observation of the different parts of the larynx, particularly the motion of the vocal cords. A glimpse of the glottis is not sufficient to determine the motility of the cords. It is necessary in many cases to wait for the child to cry and observe the movements of the cords. The child's anterior commissure laryngoscope should be inserted gently deep enough to hold the slippery epiglottis, but not deep enough to injure the vocal cords or to produce laryngostasis, which would give a misleading impression of fixity of the vocal cords. Sufficient time should be taken also to get a smear from the larynx or apply local medication when necessary.

The diagnosis of infantile beriberi alone or in combination with other diseases has been given in these cases by members of the department of pediatrics, whose clinical criterion depends on several factors, some or all of which might be present in a particular case. These are a history of breast feeding, "pastous constitution" of the child, enlarged heart, characteristic symptoms and signs and improvement or recovery on administration of vitamin B. Of the 37 cases of infantile beriberi, 5 were of acute cardialgic, 15 of aphonic, 16 of combined cardialgic and aphonic and 1 of mixed cardialgic, aphonic and pseudomeningitic beriberi. Some of these were of beriberi associated with other diseases or the mixed

forms of Guerrero and Quintos¹⁰ Two patients had acute bronchitis with aphonic beriberi, 8 had bronchopneumonia with beriberi, 3 had enlarged thymus observed roentgenologically, 1 had tracheobronchitis with beriberi, and 1 had malnutrition secondary to hypogalactia of the mother, so that beriberic syndrome instead of infantile beriberi was given finally as a diagnosis The youngest was 1 month of age and the oldest 9 months Only 7 were older than 4 months Twenty-three were from Manila and the rest from Rizal and Cavite All of them were Filipino infants Weakness of the voice ranging from hoarseness to complete aphonia was the most frequent symptom Among the other complaints were crying, cyanosis, dyspnea, rolling of the eyeballs, rigidity of the body, frequent and scanty urination, choking during breast feeding, coldness of the body, moaning, prostration, restlessness, cough and fever Rapid heart rate and accentuation of the second pulmonic sound were frequent findings Many times the lids were edematous and the face puffy Leukocytosis was a common finding in patients with pulmonary complication

Roentgenograms in 23 cases revealed enlargement of the heart without qualification as to the direction of the enlargement Five patients were reported to have cardiac enlargement to the right and 5 to the left, while only 4 had no cardiac enlargement Pulmonary changes varying from infiltration with beginning consolidation to distinct bronchopneumonic changes were present in 12 cases Enlargement of the thymus was suspected on the basis of the roentgenograms in 3 cases

All of the 37 patients received therapy with vitamin B in some form or another To the 12 patients with pulmonary complications, besides the vitamin preparations, such anti-infective medicaments as redoxon (a synthetic vitamin C preparation), blood injected intramuscularly, quinine and quinine ethylcarbonate were given Symptomatic medication with citrates, chloral hydrate, strychnine, sodium bromide, caffeine, phenobarbital and aminopyrine were given as indicated In the case of hypogalactia of the mother, artificial feeding was the main adjuvant to vitamin therapy

There was no death in this series of 37 cases of infantile beriberi, 28 patients improved considerably before they were discharged, and 9 recovered completely except for slight impairment of the voice, which in the majority of the cases persisted from several weeks to two or three months It was also observed by one of the members of the resident staff of the department of pediatrics, who followed up some patients, that the duration of the impairment of the voice seems to be little influenced by continuing the vitamin B medication after the other symptoms have improved

¹⁰ Guerrero, M, and Quintos, J El beriberi en los niños de pecho, Manila, Imprenta de Lorenzo Crib, 1910

The findings by direct laryngoscopic examination might be summarized as follows. The right vocal cord was paretic or could not move completely to the median line in 4 cases, stayed immobile in the median line in 9 and assumed a cadaveric position in 3. The left vocal cord was paretic in 5 cases, completely immobile in the median line in 9 and cadaveric in 1. The vocal cords were bilaterally impaired in 3 cases. The paretic vocal cord appeared at a lower level than the normal cord in 3 cases. All the 5 patients with acute cardialgic beriberi, in whom the impairment of voice was slight, showed only slight congestion of the vocal cords, the mobility of which was normal. In 1 case of mixed cardialgic and aphonic beriberi, the vocal cords were much congested, pinkish and flapping somewhat loosely on respiration, with slight impairment of motion on the left side. After twelve days the voice was much improved, and another laryngoscopic examination revealed no more congestion, but the left cord was slightly paretic. In another case, the left vocal cord was in the median line when first examined. After thirty-seven days in the ward, when the voice was practically normal, the cord appeared in the same position as at the first laryngoscopic examination. There was an interesting case, in which direct laryngoscopic examination was done four times. At first the left vocal cord was cadaveric. After one week there was no appreciable improvement in the voice and no change in the laryngoscopic picture. After twelve days more, the voice was improving, and the left vocal cord was slightly mobile but not completely coaptated with the right. After one more week, the voice was much improved, and the left vocal cord almost completely reached the other cord in the median line. We did not discover any sensory disturbance of the larynx in these infants. We presume that to elicit evidence of such disturbance in infants would be difficult.

There was a case of acute cardialgic and aphonic beriberi in which the heart was enlarged and the right vocal cord appeared immobile in the median line at the first laryngoscopic examination. Two weeks later, before the child was discharged with all symptoms improved except the hoarseness, a second roentgenogram revealed the heart much smaller, but laryngoscopic examination showed practically no change in the position of the vocal cords. However, in the case of the malnourished infant with an aphonic beriberi syndrome secondary to hypogalactria of the mother, the paresis of the left vocal cord completely disappeared in twelve days.

During the last three years, we have examined also a control group of 31 cases of children with diseases other than infantile beriberi whose ages varied from 18 days to 3 years. Two thirds of them were below 6 months old. Hoarseness was present in almost all cases. The other prominent symptoms were cough, cyanosis, vomiting, fever, dyspnea,

noisy respiration, nasal catarrh and frequent bowel movements. Rales were noted in many of them. Of these 31 cases the final diagnosis given by the pediatrician was acute bronchopneumonia in 10, acute laryngotracheobronchitis in 7, lobar pneumonia or bronchopneumonia with acute laryngitis in 7 and tuberculous bronchopneumonia, enlarged thymus, acute bronchopneumonia with septicopyemia, acute ileocolitis with bronchopneumonia and acute laryngitis, lobar pneumonia complicated with empyema of the chest, pertussis and paroxysmal and protracted bronchopneumonia with postdiphtheritic paralysis in 1 case each.

Roentgenograms of the heart and lungs in 17 cases of the control group revealed pulmonary lesions in 13 cases, ranging from opacity in the hilar region to pneumonic or bronchopneumonic changes. Nine hearts showed lesions, of which 4 were said to be slightly enlarged without qualification as to the direction of the enlargement and 5 showed enlargement to the left. Culture from the larynx, taken in 16 cases, showed *Staphylococcus* in 7, *Pneumococcus* in 6, *Streptococcus haemolyticus* in 5, *Monilia* in 2 and *Bacillus diphtheriae* in 1.

The summary of the laryngeal lesions in the control group is as follows. One patient had spasm of the glottis with consequent signs of asphyxia during laryngoscopic examination, so that the examination was discontinued. Twenty-two patients showed congestion of the larynx, particularly of the true vocal cords. In some patients the congestion involved the arytenoids and false vocal cords more, and some had secretion in the glottis. In all the patients, however, the mobility of the vocal cords was practically normal. In 8 patients of the control group, however, besides the slight congestion, there was impairment of motion of the vocal cords. In the patient with tuberculous bronchopneumonia, the right vocal cord stayed immobile in the median line, the patient with enlarged thymus had slight paresis of the right vocal cord, the one with septicopyemia had a cadaveric left vocal cord, 1 had distinct postdiphtheritic paralysis of the soft palate besides the paresis of the vocal cords, 1 patient with malnutrition, who had impaired mobility of the left vocal cord and an enlarged heart, was provisionally considered to have beriberi and improved after one month of administration of vitamin B₁ preparations. The patient with bronchopneumonia associated with malnutrition, immobility of the right vocal cord and a normal heart had a markedly improved voice after two weeks, without vitamin B₁ medication. One patient, who had aphonia with paralysis of the left vocal cord and bronchopneumonia, regained normal voice in four days. One patient with acute laryngotracheobronchitis and congestion of both vocal cords had slight impairment of motion of the left side but without vitamin B₁ therapy the hoarseness was gone in one week.

COMMENT

A comparison of the laryngeal findings in the cases of infantile beriberi with those in the control group shows the outstanding significance of the impairment of motion of the vocal cords in the explanation of the hoarseness in infantile beriberi. Of the 37 patients with infantile beriberi examined laryngoscopically, only the 5 cardiac patients showed no impairment of mobility of the vocal cords. All the rest had impaired motion of either the right or the left or both vocal cords, the severity varying from slight paresis with immobility in the median line to complete paralysis giving the cadaveric position. In those with complicating infection, mostly of the respiratory tract, the impaired motion of the vocal cord was evident even when an appreciable congestion was coexistent or after this had disappeared. It is noticeable also that the impairment of motion of the vocal cords remains for a long time, in most cases lagging behind the slow clinical improvement in the voice of the infant. In contrast, practically all the patients in the control group showed only congestion, with no impaired motion unless there was coexistent some such condition as tuberculosis, diphtheria, enlarged thymus or septicemia, which might explain the paresis, or paralysis. At least, in the few cases in which no satisfactory explanation existed for the impaired mobility of the cord except the inflammation of the larynx, the voice and the motion of the cords returned to normal much sooner than when of beriberic origin.

The diagnostic significance of these clinical observations is evident. In a given case of hoarseness or weakness of the voice in an infant, an impairment of the motion of the cords, which can be detected only by direct laryngoscopic examination, points to a beriberic origin or deficiency of vitamin B₁ when no other or more probable etiologic condition exists, especially when it persists for some time. Acute laryngitis, bronchitis and bronchopneumonia may produce congestion of the larynx and cords but rarely, if ever, impair appreciably the motion of the cords. If they do, the impairment may be secondary to concomitant arthritis of the cricoarytenoid joint or occasionally myositis, especially of the thyroarytenoids, and the ankylosis of the joint may be detected by palpation. The element of congestion may be considerable, but this subsides, usually within a short time, and the hoarseness and impaired mobility of the cord likewise do not last long. We recognize that persistent crying in an infant, which may in some cases be the precursor of an acute attack of beriberi, may cause some degree of hoarseness, but if they are only secondary to the crying, the hoarseness and congestion of the cords are short lasting, and there is no paralysis. It must be recognized and admitted that deficiency of vitamin B₁ (beriberi) and infection, usually of the respiratory tract, may coexist. The infection may make manifest a

latent or subclinical deficiency of vitamin B, or the hypovitaminosis may predispose to infection. Either singly may give rise to hoarseness or weakness of the voice. When they occur in combination, it becomes a diagnostic problem to determine which causes the hoarseness, whether a deficiency of vitamin B₁ coexists with the infection and, if so, to what degree. We believe that in such cases, which are frequently observed, laryngoscopic examination will bring much light to the problem, and we hope the pediatrician will come to recognize and appreciate this more and more. We believe also that impaired mobility of the vocal cord should be added to the bases for the diagnosis of infantile beriberi, heretofore generally recognized as breast feeding, cardiac enlargement, "pastous constitution," clinical symptoms and response to the therapeutic test.

We have made the foregoing clinical observations. The clinical fact remains, whatever may be its pathologic basis or the *modus operandi* of the agents which bring it about. We realize that some may disagree with us in what we are going to offer as explanation for the observed clinical facts. Hoarseness should be distinguished from weakness of the voice. It is usually difficult to differentiate them in infants. The explanation of the impaired motion of the vocal cords seems to turn on the vagus nerves, which innervate the intrinsic musculature of the larynx. In 1908 Albert¹¹ with the collaboration of Marshall and Gilman showed the presence of degenerative neuritis of the vagus nerve by autopsy of a 3 month old child with typical cardiac beriberi. Albert¹ in 1915 wrote

The failure of the extract [of tikitiki] to cure the aphonia can be attributed to a very advanced degenerative neuritis of the recurrent branches of the vagus nerve, which are the first to be affected in all cases of dietetic deficiency.

Fernando expressed the opinion that the paralysis of the vocal cord in his 2 cases of adult beriberi was probably due to degeneration of the pneumogastric nerve. Although, according to Weiss and Wilkins,¹² the theory of origin in the vagus nerve is less plausible than the myogenic theory as an explanation of the circulatory disturbances in adult beriberi, the laryngeal lesions causing the aphonia can be explained well by the nerve degeneration theory. One point strongly in favor of the neural rather than the myogenic mechanism is the long duration of the hoarseness or aphonia. It must be remembered also that in many cases of degeneration of a nerve there is first a stage of irritation or irritability of

11 Albert, J. A Case of Infantile Beri-Beri, with Autopsy Report, *Philippine J. Sc. (Sect. B)* **3** 345 (Sept.) 1908.

12 Weiss, S., and Wilkins, R. W. The Nature of the Cardiovascular Disturbances in Nutritional Deficiency States (Beriberi), *Ann. Int. Med.* **11** 104 (July) 1937.

the nerve fibers. This might be the cause of exaggerated knee jerk in some of the cases of incipient beriberi in adults. Albert⁴ in 1915 stated 'that infantile beriberi under a clinical aspect is principally a vagotonia—an abnormal irritability of the vagus'.

In regard to paralytic diseases of the larynx, it is well to remember Semon's law, which according to Jackson and Coates,^{6b} should be considered more of a rule than a law as there are exceptions. It states that in organic lesions of the recurrent laryngeal nerve or the center from which it is derived the abductor fibers are affected first the tensors second and the adductors last. According to Negus¹³ this rule follows evolutionary changes, since in the phylogenetic scale the abductor fibers are the latest to be acquired and they are therefore more vulnerable although not necessarily more superficial.

How shall one explain the different kinds of paralysis by this rule of Semon? In the first place the paresis that we observed was a sluggishness and limitation of the movement of the cord medially so that it did not reach the other cord at the median line. We have not observed well whether the cord has also any impaired mobility outward. This observation may be explained by paralysis of the adductors but this is usually functional and rarely occurs initially and alone, and hence the possibility is remote. It may be due to increased tonicity from irritability of the abductors causing them to counteract the adductors. This would produce the sluggish and limited medial motion of the cord. The latter consideration is possible if one believes that irritability of the whole vagus nerve or only of its abductor fibers may occur before the degenerative changes take place. This may not exactly conform with the results of experimental stimulation of the vagus nerve,^{6a} because it is difficult to stimulate electrically or otherwise only the abductor fibers without stimulating also the adductor and the tensor fibers.

Then in the more advanced stage, when the abductor fibers have degenerated, the adductors unopposed, keep the cord immobile in the median line. But one must assume the existence of some paresis or weakness of the tensors to produce hoarseness even when the two cords approximate in the median line. When the tensors are much affected, the cord may be so lax as to appear to lie below the level of the opposite normal cord as is observed in some cases. Again, the influence of the tensors may be cited to explain the observation of an improved or normal voice with one cord persistently immobile in the center. In such cases the tensors must have recovered but not the abductors, and the cord becomes tense and vibrates although immobile in the median line.

¹³ Negus, V. C. *The Mechanism of the Larynx*, St. Louis, C. V. Mosby Company, 1929.

In the final stages, when the degeneration has involved practically all the nerve fibers, abductors, tensors and adductors, the cord shows complete paralysis and assumes the cadaveric position

We would quote in this connection the following statement by Jackson and Jackson ^{6a}

Pathologic considerations are fundamentally important, but as clinicians we must remember that any one or more of the three groups of muscular systems may be affected unilaterally and bilaterally. We should be guided entirely by our knowledge of anatomy and of the normal laryngoscopic image and record what we see objectively when examining the larynx.

These clinical observations that we have made in infantile beriberi point to the pathologic similarity of adult and infantile beriberi, at least in the laryngeal lesions. As to the cause of this vagal degeneration, cardiac pressure seems remote, since some of the patients have no cardiac enlargement and among those who do there exists no constant correspondence between the side of the heart enlarged and the cord paralyzed. According to the most widely accepted view, the cause is deficiency of vitamin B₁. This view is supported by the clinical improvement that occurs when vitamin B₁ is administered. In the final analysis, according to the recent theory that intoxication brought about by an intermediate product causes the neural and myocardial degeneration and other lesions, they are still indirectly caused by deficiency of vitamin B₁. Is it possible also that the different types of impaired motion of the vocal bands need not exactly represent stages of severity in all cases but are evidence of the so-called focal localization of deficiency of vitamin B₁?

SUMMARY AND CONCLUSIONS

Thirty-seven patients with infantile beriberi, of whom 5 had acute cardialgic, 15 aphonic, 16 combined cardialgic and aphonic and 1 mixed cardialgic, aphonic and pseudomeningitic beriberi, were submitted to direct laryngoscopic examination. Eleven of them had the disease complicated by acute infection of the respiratory tract. The youngest was 1 month of age and the oldest 9 months. All except 7 were below 4 months old. Hoarseness and weakness of the voice, or aphonia, was the most frequent symptom. The final diagnosis of infantile beriberi was given in all these cases by the pediatrician.

The laryngeal lesions found may be summarized as follows. The 5 patients with acute cardialgic beriberi, in whom the impairment of voice was slight, showed only slight congestion of the vocal cords, their motility being normal. All the rest had impairment of motion of the vocal cords. The right vocal cord was paretic or could not move completely to the median line in 4 cases, stayed immobile in the middle in 9 cases and assumed a cadaveric position in 3 cases. The left vocal cord

was paretic in 5 cases, completely immobile in the median line in 9 cases and cadaveric in 1 case. The vocal cords were bilaterally affected in 3 cases. In some cases the paretic vocal cord appeared at a lower level than the normal.

A control group of 31 children with diseases other than infantile beriberi but with hoarseness as a complaint also were examined laryngoscopically. Twenty-two of these showed only congestion of the vocal cords, which moved normally. The rest had impairment of movement of the vocal cord, but in almost all of them there was a coexistent pathologic condition which might explain the paresis. In the rare cases in which the impairment of motion seemed to be entirely attributable to the inflammatory congestion of the larynx, the hoarseness and the impaired mobility were short lasting in contrast to their long duration in the cases of beriberi.

We believe that impaired mobility of the vocal cords should be added to the already recognized factors in the criterion for the diagnosis of infantile beriberi. In cases in which beriberi and acute infection of the respiratory tract coexist, the motility of the cords is of help in determining whether both are present and what degree of deficiency of vitamin B₁ exists in the child.

The *modus operandi* in the production of the clinical facts observed seems to be first the irritation and then the degeneration of the abductor fibers of the vagus nerve followed by similar changes in the other fibers, the tensors and adductors. The cardiac enlargement does not seem to have any influence on the degeneration.

Clinically and probably pathologically, at least with regard to the laryngeal lesions, there is a close similarity between adult beriberi and infantile beriberi.

OROANTRAL OPENINGS AND THEIR SURGICAL CORRECTION

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If the maxillary sinus is opened in the course of the removal of a tooth or during some other oral operation, several clinical signs give immediate warning. The more common ones are escape of blood from the nostril, escape of air into the oral cavity during expiration, frothing of blood from the tooth socket and escape of liquids from the mouth through the nostril. These signs are often followed rapidly by local pain and inflammation within the sinus. Even suppuration and empyema may supervene within twenty-four to forty-eight hours. Furthermore, these local manifestations may be supplemented by more or less pronounced general symptoms of acute infection.

In addition to the infection, the following important factors, besides others, help to determine the effect of the opening in individual cases: the cause of the opening, the conditions under which it occurred, its duration, the extent of immediate laceration of, and later changes in, the surrounding tissues, the location of the opening, the presence of adjoining teeth, the presence of pathologic conditions around the site of the removed tooth, and, finally, the condition of the sinus proper and of the associated anatomic structures.

A considerable proportion of these openings close by granulation, as would an ordinary tooth socket. In a certain percentage, closure is delayed but still takes place without surgical intervention. In other cases, the opening remains patent and can be closed only by means of an operation. In any case natural closure should be encouraged and not retarded or prevented by unnecessary or injudicious packings of the tooth socket carried into the sinus.

PRELIMINARY CONSIDERATIONS

Dental Relations and Local Pathologic Conditions—It is well to have a clear understanding of the dental relations and the nature of the local pathologic conditions, since these induce characteristic morbid processes which should influence or determine the mode of treatment.

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Specifically, it is important to know whether the tooth removed was alive or devitalized and infected and whether there was any pathologic condition around the tooth, such as a cyst, granuloma or abscess of bone. These pathologic processes may in themselves directly penetrate into the maxillary sinus. On the other hand, neoplasms of the maxilla which invade the maxillary sinus are comparatively rare and will not be considered in this article.

In the removal of normal teeth the sinus may be broken into because of the anatomic relation or through natural inadvertence in the operative procedure. Infection may develop soon even in clean openings of this type, but it frequently yields to thorough irrigation if instituted promptly, the cannula being introduced into the oral opening and the fluid escaping through the nostril with the patient's head bent forward. In such cases the opening often granulates and closes uneventfully.

The presence of infected teeth, the roots of which project into the sinus proper, often leads to an acute or chronic suppurative process, usually characterized by periodic exacerbations, degeneration of the lining membrane and formation of polyps. Chronic fistulous dental abscesses presenting little or no roentgenographically demonstrable destruction of bone may drain into the sinus. Sometimes a pyorrhea pocket is found extending beyond the end of the root of a tooth and into the maxillary sinus. Such a pocket acts like an abscessed tooth. These findings should not, however, be construed as meaning that the presence of devitalized teeth is necessarily an etiologic factor in sinus infection. Such unmeasured conclusions are prone to lead to erroneous diagnosis and to unnecessary loss of teeth. Roentgenograms are helpful and often dependable diagnostic agents in this connection, but they should be interpreted with the utmost care.

Cysts and granulomas, often associated with diseased teeth, are structurally circumscribed, and, even though infected, they give some protection to the surrounding bone, often invaginating the approximating wall or laying bare the schneiderian membrane without actually penetrating it. Larger cysts may become continuous with the sinus. When acute suppuration develops, the pus may evacuate into the maxillary sinus.

Pathologic Conditions of the Sinus—The condition of the sinus proper should be determined as clearly as possible. The maxillary sinus often harbors low grade infections without causing disturbing symptoms. It may be assumed, therefore, that the acute symptoms which arise when these unexpected openings are formed are not always due to the entrance of oral bacteria, as in a large proportion of cases no infection develops despite the unavoidable contamination. Some may be due to the activa-

tion of an existing dormant infection. Nevertheless, the likelihood that infection follows because of the opening cannot be excluded. Cases in which ascending infection developed with fatal results have been reported. The extent of trauma, the bacteriologic picture and the proneness of the patient to infection also should be considered as factors in the final determination of the cause.

An anteroposterior roentgenogram taken immediately on establishing such an opening may be suggestive in this respect. If there is no history of previous difficulty and the sinus appears to be clear, it may be assumed that it was normal. If the roentgenogram of the sinus shows clouding, which is commonly, though not always, caused by pathologic changes, it may be assumed that a chronic infection has existed there before.

When one is preparing to close a sinus the existing condition should be carefully studied. The previous history, the roentgenogram and transillumination are helpful and suggestive, but the actual condition is best disclosed at operation.

When diseased teeth are present, the diseases which affect the bony floor are not easily demonstrated by the roentgenograms and for this reason or from want of appreciation are frequently overlooked. The bone may be necrotic or permeated with pus. Within the cavity masses of crumbling polyps mixed with pus and other detritus usually accumulate in consequence of prolonged chronic inflammation and suppuration. The membrane lining the floor and the lower third of the cavity may be necrotic while a large part of that covering the upper part of the cavity is intact and normal in appearance.

The aim should be to remove the diseased portion and preserve the apparently good part of the lining membrane. The diseased membrane is of poor texture and often jelly-like and can be wiped away with a sponge or removed with a ring curet.

Prognosis—This discussion is confined to cases in which the disease is of dental origin and lies within the maxillary sinus alone. In other types of case treatment is more appropriately and effectively managed by the rhinologist, alone or jointly with the oral surgeon.

In the cases of restricted disease of dental origin it can safely be anticipated that by eradicating the oral or dental factors and the pathologic conditions from within the sinus permanent cure will be effected. However, prognostication should always be made with a degree of reserve, as a sinus which was diseased and has been operated on is more prone to infection and complications than is a normal one. With the impairment or destruction of the ciliated epithelium which normally surmounts the lining membrane the tendency to infection is increased.

For this reason the apparently intact part of the lining membrane should be preserved. Even when damaged this tissue is capable of

repair and may regenerate to some extent. Such reconstructed tissue is more normal and more acceptable than is newly laid down repair tissue.

Foreign Bodies—An oroantral fistula should never be closed without careful inspection and exploration of the cavity for foreign substances, which may find their way there from the oral cavity. That the irrigating solution is returned clear is not always reassuring in this respect. In 1 case two wads of chewing gum were found even though the fluid had been returned clear for some time.

The foreign body most commonly found is a tooth or a fragment of a tooth. It may be forced there in the removal of teeth or by external violence. An example is presented in figure 1, from the case of a boy of 14. He was struck with a baseball bat, and the partly formed third molar was driven into the sinus. A roentgenogram made in the case

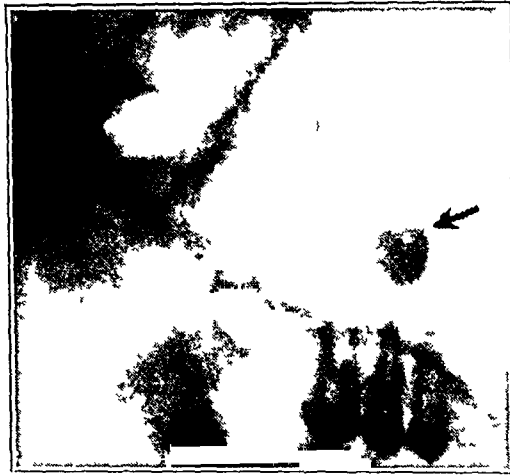


Fig 1—A partly developed third molar driven into the maxillary sinus with a baseball bat

of a woman of 23 is presented in figure 2. She was having an impacted upper third molar removed under nitrogen monoxide and oxygen anesthesia, and the tooth was forced into the maxillary sinus.

A tooth or a portion of a tooth forced into the maxillary sinus should be promptly removed, as it always becomes and acts as an infective foreign body. Sometimes it is possible to remove such a tooth through an enlargement of the original opening. In both the cases cited the teeth were lodged at a distance which made them inaccessible, and it was necessary to make an opening at the base of the malar protuberance over the first molar and the bicuspid teeth.

A more common accident is the forcing of a fragment of root into the sinus. Such a fragment may remain close to the point of entrance, or it may be projected some distance from the opening. Removal through an enlargement of the original opening may be attempted if conditions are favorable. When it is successful, the soft tissues are approximated

in a favorable position for closure. With a clean sinus, such a result is all that is desired.

Drainage—Until about a decade ago, it was an accepted practice, as in the Cooper operation, to establish drainage for empyema of the antrum through a tooth socket. The opening was maintained with a metal tube or hard rubber plug attached to the teeth or to a dental restoration. The sinus was often irrigated by the patient once or twice a day. Accidental openings were treated on the same principle.

The patients were fairly comfortable but were harassed through the years by the need of this awkward attention and by the constant fetid chronic suppuration. Their physical discomfort was aggravated by embarrassment due to the miasmatic emanation which penetrated to those in their proximity. Today this procedure is obsolete and probably rightly abandoned.



Fig 2—A third molar forced into the maxillary sinus in an attempt at removal.

The question arises: How soon should a sinus be closed by operation? One cannot be dogmatic or specific on the subject. If a sinus fails to close within three or four weeks, experience has shown that it is not likely to do so without an operation. With epithelization of the opening or progression of healing beyond the stage of granulation, the cicatrix becomes fixed. The aperture may become smaller, but complete closure does not take place (fig 3).

Before one closes the opening, the obvious suppuration should be eliminated. The oral opening should be closed even when drainage into the sinus from another source may require treatment through the nasal route, as permanent cure cannot be obtained while communication between the mouth and the maxillary sinus exists.

CLOSING THE OROANTRAL OPENING

Closing of an oroantral opening is not always a simple or a successful procedure. Even recent literature indicates that the operation is often

performed without a definite plan and often ends in uncertainty as to complete closure. This was my experience until the technic here presented was developed in full detail. If the steps of the operation are carefully observed, a good result is practically always obtained.

The procedure may best be described as a "*sliding flap operation*". The following underlying principles must be closely observed:

- 1 The flap should have a broad base to insure a liberal supply of blood and so minimize the chances of sloughing or necrotization.

- 2 The flap must be freely mobilized to prevent tension.

- 3 The edges to be apposed should be pared so that all epithelized surfaces, tissue of poor texture and cicatricial tissue are removed.

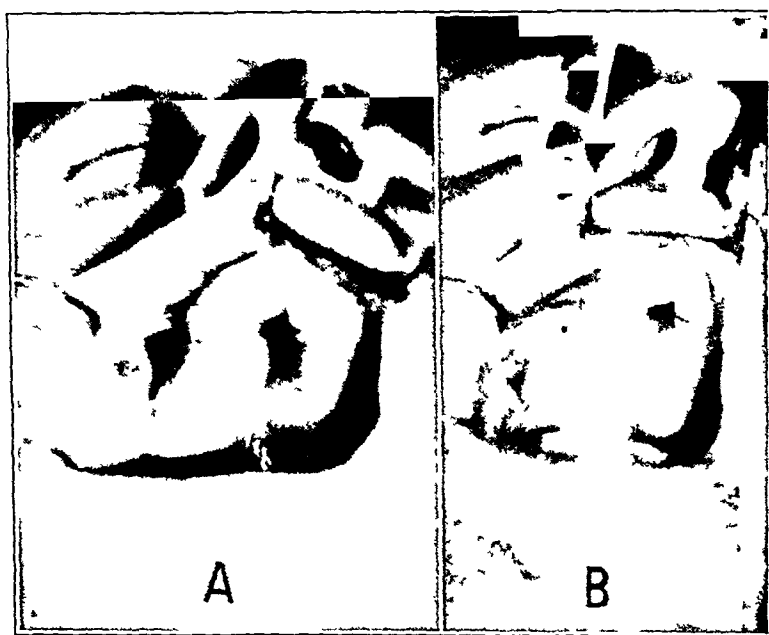


Fig 3—*A*, an opening into the maxillary sinus of about two years' duration. Cicatrization is complete, and the surfaces are epithelized. Actual cauterization or the application of escharotics will not induce or effect closure. *B*, the opening closed.

- 4 All the original tissue and cicatricial tissue of good texture, of which there is never too much, should be preserved.

- 5 Angulation caused by a sharp crest of bone may interfere with circulation. It is to be remembered that a flap which fits loosely at the time of the operation may become taut with postoperative edema during the first twenty-four or forty-eight hours and later through cicatricial contraction.

- 6 Clearly viable surfaces should be accurately apposed and coapted. Interposition of an epithelized surface or gaping of the wound at a point which is not supported by bone will prevent union.

7 Traumatization and maceration of the tissue should be avoided, especially at the edges, where primary union must take place

8 Sutures should be placed which will maintain the relation of the tissue until union has taken place

Preparation of the Flap—An opening which followed the removal of a second molar is shown photographically in figure 4 The first step



Fig 4—An opening into the maxillary sinus of six weeks' duration which followed the removal of a second molar The edges of the mucous membrane are turned in The gum tissue at *A* is inelastic and strongly adherent to the bone The folds of mucous membrane at *B* are flexible and elastic These folds of tissue can be displaced to advantage only after the periosteum has been released

in closure is the excision of the tissues which form the lip of the orifice (fig 5 *A*) From the extreme edges diagonal incisions are made through the mucoperiosteum to the bone (fig 5 *B*) These incisions should be divergent enough to maintain an abundant supply of blood and yet permit of the flexibility necessary in displacing the flap When the bony opening is large or is enlarged in the operation, the edges of a

broad-based flap will be better supported by the bone. This is an important detail, as incomplete closure is often due to the fact that too large an area of the flap is unsupported. In these cases, if primary union fails the edges of the wound become separated or are curled by cicatricial contraction.

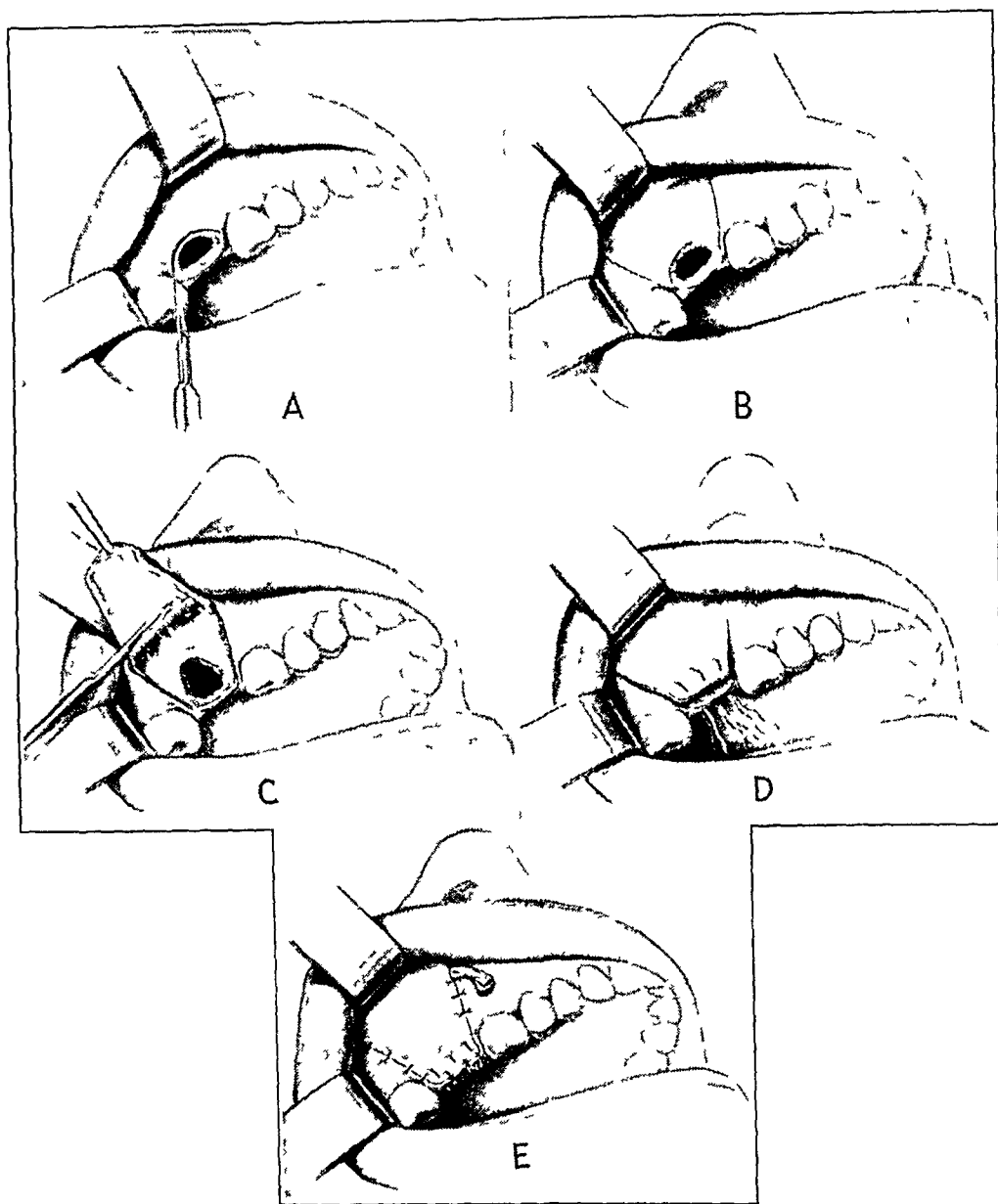


FIG 5—*A*, first step in the operation. The edge of the opening is excised, and a vivified surface is secured. *B*, two divergent incisions are carried from the extreme edges of the opening into the folds of tissue shown at *B* in figure 4. *C*, the flap is raised and the bony opening made large enough for inspection and for the removal of the diseased contents of the sinus. Several horizontal incisions are made through the periosteum as indicated, with the scalpel. *D*, the flap is trimmed to meet the palatal edges of the opening, and mattress sutures are introduced over the area where bone is lacking to secure definite coaptation. *E*, the mattress sutures are reinforced, and closing is completed, with interrupted sutures. The end of the iodoform gauze is shown protruding from the uppermost part of the wound.

It will be noted that even though the flap raised appears to be ample, it is not possible to appose the edges of the wound. Examining the mucosa, one sees that the tissues over the periosteum present loose and elastic folds, as shown in figure 4 at *B*. If properly treated, these should permit the necessary displacement. Stretching is prevented, however, by the closely woven and inelastic periosteum. To make the necessary approximation possible, the periosteum must be released. This is done by severing the periosteum alone at different levels without penetrating deeply where the blood vessels are lodged (fig 5 *C*). The thickness of the flap should be preserved at the points of incision in so far as is possible. The periosteum should not be released at points too close to each other or too near the edges of the flap. Here the terminal vessels are nearer to the surface, and encroachment may lead to impairment of the supply of blood, sloughing and necrotization. When the periosteum is thus released, moderate traction may be exerted at the points of incision until the flap is loosened, so that the edges of the tissue do not merely meet but overlap.

The edges are further pared if necessary for accurate approximation. Epithelized surfaces and poorly vascularized repair tissue which meet over the opening are removed, as here one depends entirely on primary union. If it fails, closure will almost always be incomplete.

Little comfort is to be derived from the fact that a secondary opening is so small that it barely permits the passage of a fine probe. However small the opening, oral secretions, bacteria and food will pass through, and constant irritation and reinfection usually result. The parts which are remote from this vulnerable point and which are sustained by the underlying bone always close. In fact, it would be difficult to maintain an opening in such parts or higher in the vestibule.

The next important step is accurate suturing. Apposition of the viable surfaces is secured with mattress sutures in the area overlying the opening, as shown in figure 5 *D*. The mattress sutures should be reinforced with interrupted ones. The rest of the wound is closed with interrupted sutures (fig 5 *E*).

Postoperative Care—There are several views on the subject of dressing and postoperative care in these cases. Some favor permitting the sinus to close by primary intention without further care. Others provide drainage, as in the Caldwell-Luc operation, through a puncture in the nasal wall.

It is my practice to introduce 12 to 15 inches (30 to 38 cm) of $\frac{1}{2}$ inch (1.27 cm) 5 per cent iodoform gauze into the uppermost part of the buccal fold between the last suture and the termination of the incision. The gauze is matted down on the floor of the cavity where most of the bleeding occurs, but no attempt is made to pack the sinus. In experience, immediate complete closure is not always good practice. It is desirable

to remove by lavage the postoperative blood clot, which frequently breaks down and becomes infected. Furthermore, during a period of the healing process there is the cicatricial ooze always pronounced in granulating larger bony surfaces, which is likewise subject to stagnation and infection. In several cases in which no provision was made for postoperative care, infection followed and a nasal puncture had to be made to get rid of it.

The gauze is left undisturbed during the first forty-eight hours and is removed in parts in two or three days to prevent secondary hemorrhage. The sinus is lavaged during the first week or ten days with tepid physiologic solution of sodium chloride.

The soundness of this practice in the type of case here described is confirmed by the fact that secondary complications were noted in only a few cases. The nasoantral wall was always left intact. Preserving this normal state probably contributed to the success. This procedure may not apply equally well when complications are present in the nose or the other accessory sinuses.

SUMMARY AND CONCLUSIONS

An oroantral fistula may become established because of the following conditions:

- 1 In the removal of a normal or an impacted tooth, because of the anatomic relation, without pathologic conditions
- 2 Through operative inadvertence in the removal of teeth
- 3 Through infections, cysts and neoplasms, which may destroy the intervening bone so that the sinus becomes involved
- 4 Through traumatic injuries associated with fracture of the bony wall and a break in the continuity of the mucous membrane
- 5 Through loss of bone following osteomyelitis and necrosis of the maxillary bone, with destruction of the soft tissues

These openings lead to infection of the sinus and degeneration and destruction of the schneiderian membrane. They should be closed promptly, therefore, after the obvious infection has been eliminated. Foreign bodies, such as teeth, fragments of teeth or other substances which may find their way into the cavity, should first be removed.

The advantages of the "sliding flap" operation here described are as follows:

- 1 The palatal tissues remain intact, with an undisturbed surface relation and blood supply
- 2 No bony surface remains exposed to be filled in and covered with granulation tissue

3 When the tissues are properly approximated and sutured, union takes place by primary intention, except at points intentionally kept open for drainage and irrigation

4 The buccal flap is merely an extension of tissue normal to the parts

5 In the course of time, surface adaptation occurs which is more like that of the alveolar ridges in outline (While this is not important from the surgical standpoint, it is desirable for later dental prosthetic restorations)

6 The fact that the floor of the antrum after healing may be somewhat higher and nearer to the ostium than it was originally may be advantageous in the cleansing of the cavity

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CONSTITUTIONAL BACKGROUND OF INFECTION OF THE UPPER PART OF THE RESPIRATORY TRACT

JOHN B PRICE, M D

NORRISTOWN, PA

For many ages textbooks and physicians dealt scantily with infection in the upper part of the respiratory tract. Writers of textbooks invariably relegated it to a minor place. Most books on medicine began with another subject, as typhoid or perhaps pneumonia. Today this is quite changed. Infection of the upper part of the respiratory tract, its serious attending sequelae and its accompanying bodily reactions probably are dwelt on more adequately and investigated more attentively than at any time since the dawn of modern medicine. The problem is not new, it has been discussed and written about in many ages and many climes. Long before modern medicine was evolved it was present. Herodotus¹ said concerning the Egyptians in 425 B C, "physicians swarmed all over Egypt and treated every disease as a local disorder," and "some," he said, "treated diseases of the eye and head only." He further stated that the people complained to the emperor that this should be changed and the physician made to treat the body as a whole.

In Burton's "The Anatomy of Melancholy,"² written in 1620, reference is made to Heurnius, a Dutch physician and writer who lived in the middle of the sixteenth century, who, in searching for causes of diseases of the mind, ascribed one division "to excrements of the brain, catarrhs, sneezing, rheums and distillations of the body." Here are two widely divergent thoughts, one antedating the first century A D.

I think it was about thirty years ago that an eminent American bacteriologist enunciated his theory of focal infection and the relation of bodily diseases to pathologic changes in, and infection of, the head. I believe he created a great deal of discussion.

In 1915 Billings,³ a Chicago physician and author, delivered ten consecutive lectures on focal infection at Stanford University. Almost

Read at a meeting of the Philadelphia Laryngological Society, May 2, 1938

1 Herodotus. History, translated by G. Rawlinson, New York, Tudor Publishing Co., 1932, p. 108.

2 Burton, R. The Anatomy of Melancholy, ed. 6 (1651), translated by F. Dell and P. Joran-Smith, New York, Farrar and Rhinehart, Inc., 1929.

3 Billings, F. Focal Infection. The Lane Medical Lectures, New York, D. Appleton and Company, 1916.

every one has attacked the problem from the point of view of focal involvement. My object in this paper is to combat the thesis underlying such an attack.

It is an old observation that certain persons suffer much more frequently from infections of the upper part of the respiratory tract than others. If one considers the whole population of a certain area, exposed to the same or similar environmental factors and exogenous agents, such as infections, the fact that only a certain portion of the population is affected by infections of parts of the upper respiratory passages seems to indicate that endogenous constitutional factors play a role in the pathogenesis of such infections.

In any study of the role of the constitution in the genesis of a disease it seems necessary not only to demonstrate the importance of this factor by statistical methods but to analyze the mechanism by which the abnormal constitution causes susceptibility to a certain disease.

Without the possibility of resorting to laboratory methods of research or the facilities for experimentation on animals, such as cats, guinea pigs and mice, one has to approach this subject from an empiric standpoint. Scientific proof or formulas must give way to observation, and one must proceed empirically and clinically. Therefore, the confirmation of my hypothesis will be based on observation of a large number of patients, both institutional and private.

A number of authorities have found constitutional dyscrasia the governing factor in infections of the upper part of the respiratory tract. Bauer and Stein⁴ found that infections of the middle ear occur in certain families with peculiar hereditary taints, pursuing an unusually protracted course, and in a great many instances observed an abnormal structure of the eustachian tube or the middle ear.

Wittmaack⁵ noticed differences in the development of pneumatic cells of the temporal bone and also anatomic and histologic differences in the structure of the mucous membrane.

Schaeffer⁶ stated that many reflex and referred nasal manifestations that occur in nasal disease can be accounted for by the anatomic arrangements and relations of neurons composing neuron circuits.

Kutepow⁷ found otitis media in many patients of the lymphatic and asthenic constitutional type.

4 Bauer, J, and Stein, C. *Konstitutionspathologie in der Ohrenheilkunde*, Berlin, Julius Springer, 1926, p. 82.

5 Wittmaack, K, in Henke, F, and Lubarsch, O. *Handbuch der speziellen pathologischen Anatomie und Histologie*, Berlin, Julius Springer, 1926, vol. 12.

6 Schaeffer, J. P. *The Nose, Paranasal Sinuses, Nasolacrimal Passageways, and Olfactory Organ in Man*, Philadelphia, P. Blakiston's Son & Co., 1920, p. 294.

7 Kutepow, J. P. Ueber die Bedeutung des Konstitutionsmoments in der Pathogenese der Ohrenkrankungen, *Ztschr. f. Hals-, Nasen- u. Ohrenh.* 9: 497, 1925.

Spira⁸ observed that patients with other degenerative conditions, such as lymphatic hypertrophy and endogenous diseases, are more often afflicted with disease of the upper part of the respiratory tract than are those of any other type

Siemens⁹ and Weitz^{9a} found peculiar reactions of the mucous membrane in patients with lymphatic hyperplasia

Bauer and Stein¹⁰ stated that it is most important to examine the noses and throats of those who have any constitutional anomaly

In 1925 Kutepow¹¹ compiled observations on infections of the head. Of 47 patients, 43 were distinctly of the lymphatic and asthenic constitutional type, and little if any progress was made in treating them

Jarvis¹² reported observations and statistics collected by "fifty nationally known medical men". He said that the "mucous membranes of the upper respiratory tract present different colors in the sympathetic and the parasympathetic type, which gives one an indication of the constitutional type of the patient with whom one is dealing". In a private communication (1936) he stated that the problem is basically one of oxygen metabolism, in which bodily catalysts or activators play the most important part in building and rebuilding bodily cells. He stated that "disease begins when cells do not get a proper quality or quantity of food and oxygen, thus, the factors constituting the fundamental life of the cell being interfered with, departure from the normal chemical constitution of the body begins". He concluded that the problem in disease of the upper part of the respiratory tract is not one of infection but one of oxygen metabolism

Draper¹³ complained against the habit of clinging to mechanistic tradition in treating sinus disease in relation to its etiology

Fenton¹⁴ said, "Influences of a general order with definitely lower resistance in susceptible persons especially chilling of the body

8 Spira, R. Ueber Hereditat bei Ohrenkrankheiten, *Monatschr f Ohrenh* **48** 354, 1914

9 Siemens, H. W. Die Zwillingspathologie, ihre Bedeutung, ihre Methodik, ihre bisherigen Ergebnisse, Berlin, Julius Springer, 1924

9a Weitz, cited by Siemens,⁹ p 101

10 Bauer and Stein,⁴ p 108

11 Kutepow, cited by Bauer and Stein,⁴ p 90

12 Jarvis, D. C. Changes in the Color of the Intranasal Mucous Membrane as a Guide to the Status of the Sympathetic and of the Parasympathetic System, *Arch Otolaryng* **21** 131 (Feb) 1935

13 Draper, G. Human Constitution. A Consideration of Its Relationship to Disease, Philadelphia, W. B. Saunders Company, 1924

14 Fenton, R. A. Non-Infectious Factors in the Etiology of Sinus Disease, with Special Reference to the Reticulo-Endothelial System, *Tr Am Laryng, Rhin & Otol Soc* **36** 128, 1930

surface," with particular reference to the reticuloendothelium, may play a large part in the process of infection of the upper part of the respiratory tract

In the discussion following Fenton's¹⁴ paper, Lee M. Hurd said, "Sinus trouble does not start from a bacterial focus. I think it is allergic. There is also a vitamin influence."

Ruskin said, "The autonomic nervous system in the nose is related to the reticuloendothelial system, this probably reacts on the autonomic system, causing vasomotor changes in the nose."

Lewy, of Chicago, said, "Study of the underlying constitutional factors in disease is making itself felt in all branches of medicine."

Fenton and Larsell,¹⁵ of the University of Oregon Medical School, Portland, in 1931 reported research work which indicated the importance of the production of histiocytes and their relation to the reticuloendothelial system in the nasal mucosa in the defense mechanism against infection of the upper part of the respiratory tract.

In order to study the influence of constitutional factors in infections of the upper part of the respiratory tract, two groups of subjects were examined.

One of these groups was selected from 754 male and female students at a college (Ursinus College, Collegeville, Pa.) and was composed of young men and women who came from good, solid, substantial, middle class families, representing the average, normal type. The other group was a cross section of the inmates of an institution which contains persons, both male and female, of degenerative types (Pennhurst State School, Pennhurst, Pa.). Members of both these groups live in the same vicinity, the institutions being within 10 miles (16 kilometers) of each other. The tabulations are intended to give light on the constitutional backgrounds of persons of both groups and the percentage suffering from infective disease of the upper part of the respiratory tract. It is obvious that subjects of the degenerative type are more affected by the constitutional factors in their basic background than are those of the other type, who are slightly affected. The first tabulation represents data on students of Ursinus College over two years. The diagnosis was made from the history and from clinical examination by me. In this series, it will be noticed, there are 23 patients with a history of a definite infection, 18 of the 23 offered no information of interest aside from a history of such diseases as pneumonia, heart disease and common diagnostic entities. However, 5 had a definite history of tuberculosis in the parents.

¹⁵ Fenton, R. A., and Larsell, O. Some Experimental and Clinical Observations on "Reticulo-Endothelial" Components of Accessory Sinus Mucosa, *Tr. Am. Acad. Ophth.* **36**: 225, 1931.

Subject	Family History	Personal History
J A	No contributory data	Infection of posterior ethmoid sinus
C B	No contributory data	Ethmoiditis
I K	No contributory data	Infection of ethmoid sinuses
A M	No contributory data	Bilateral infection of ethmoid sinuses
F M	No contributory data	Infection of ethmoid sinuses
F S	Tuberculosis	Chronic infection of ethmoid sinuses
F T	No contributory data	Bilateral infection of ethmoid sinuses
R Y	Tuberculosis	Chronic ethmoid and maxillary sinusitis on left
I B	No contributory data	Infection of maxillary and ethmoid sinuses
F B	Tuberculosis	Purulent infection of maxillary and ethmoid sinuses on right side
V J	No contributory data	Infection of ethmoid sinuses
N P	No contributory data	Infection of ethmoid sinuses
H S	No contributory data	Infection of ethmoid sinuses
R M	Tuberculosis	Infection of ethmoid and maxillary sinuses, old infection of ear
N D	No contributory data	Mastoiditis at 3 years
E F	No contributory data	Chronic otitis media
S K	No contributory data	Mastoiditis at 10 years
A L	No contributory data	Chronic otitis media
R M	No contributory data	Mastoiditis at 15 years
N L	No contributory data	Mastoiditis at 7 years
L W	Tuberculosis	Mastoiditis at 9 years
J C	No contributory data	Otitis media
R W	No contributory data	Chronic otitis media

In the second tabulation are data on 42 patients selected from 100—a cross section of the inmates of an institution for persons of definite constitutional types involving degenerative and acquired conditions in the familial background, the Pennhurst State School at Pennhurst, Pa

Subject	Family History	Personal History
R D	Mother died of tuberculosis, siblings feeble-minded	Numerous infections in upper part of respiratory tract, bilateral otitis media, bilateral mastoidectomy, mastoid tip on right side, not removed, causing moderate discharge
V M	Father murdered mother	Epilepsy, numerous infections of upper part of respiratory tract, chronic otitis media
J D	Father alcoholic, died of tuberculosis, mother psychotic and alcoholic	Bilateral otitis media with more severe involvement on left side
C R	Father nervous but otherwise in good health, mother well	Epilepsy, chronic bilateral otitis media, numerous infections of upper part of respiratory tract, enlarged infected tonsils
L T	Siblings feeble-minded	Chronic otitis media on right side, infected tonsils
C G	Mother and siblings feeble-minded	Chronic otitis media, infections of upper part of respiratory tract
F W	Father low grade, he and one of his brothers deaf, mother of low morality, siblings feeble-minded	Infected tonsils and adenoids, many infections of upper part of respiratory tract, otitis media, secondary infection of lungs due to postnasal drip
A K	Father healthy, mother defective	Numerous infections of upper part of respiratory tract, chronic otitis media
G L	Father healthy, mother feeble-minded and syphilitic	Numerous infections of upper part of respiratory tract infected tonsils and adenoids, chronic otitis media
W M	Siblings retarded	Infections of upper part of respiratory tract, cervical lymphadenitis, chronic otitis media
J S	Father alcoholic, mother feeble-minded	Infections of upper part of respiratory tract chronic otitis media
R N	Nothing known	Deviated nasal septum chronic otitis media, infected tonsils
J C	Father feeble-minded, mother had 8 stillborn children, 2 of 5 siblings apparently normal	Tonsillitis, infections of upper part of respiratory tract
R H	Father had dementia praecox, apparently arrested, mother feeble-minded, 6 siblings, all feeble-minded	Infections of upper part of respiratory tract many attacks of tonsillitis
F R	Mother insane	Chronic mastoiditis numerous infections of tonsils and adenoids, infections of upper part of respiratory tract
A B	Parents apparently normal	Whooping cough, epilepsy, prolapse of rectum, infections of upper part of respiratory tract, chronic infection of both ears

Subject	Family History	Personal History
M W	Father healthy, mother in poor health and said to be epileptic, 1 sibling probably mentally defective	Infections of upper part of respiratory tract, many attacks of tonsillitis
T B	Mother in insane asylum 7 siblings all feeble-minded	Measles, whooping cough, numerous infections of upper part of respiratory tract
W G	One feeble-minded sibling	Chronic otitis media, infection of upper part of respiratory tract
M A	Parents apparently normal	Pneumonia, measles, whooping cough, mumps, epilepsy, infection in upper part of respiratory tract, sinusitis, otitis media, infected tonsils
P E	Parents apparently normal	Measles whooping cough, chickenpox, diphtheria, epilepsy, numerous infections of skin, chronic otitis media infections of upper part of respiratory tract defective tonsils
J K	Father in insane asylum, mother apparently normal	Whooping cough, syphilis, otitis media, tonsillitis infections of upper part of respiratory tract
J W	Parents apparently normal	Mongolism, infections of upper part of respiratory tract, purulent rhinitis, sinusitis, otitis media
W S	Family of poor stock	Microcephalia, internal strabismus, infections of upper part of respiratory tract, tonsillitis
R P	Family, apparently normal	Mongolism, infections of upper part of respiratory tract, sinusitis, mastoiditis
C P	Father alcoholic, mother apparently normal, siblings mentally defective	Measles chickenpox, whooping cough tonsillitis, infections of upper part of respiratory tract
R A	No history of mental deficiency in family	Infections of upper part of respiratory tract, chronic otitis media, neurologic disease
M Z	Some mental retardation in siblings	Pneumonia and measles, infections of upper part of respiratory tract
H D	Mother has tuberculosis	Hydrocephalus, chronic otitis media, infections of upper part of respiratory tract infected tonsils and adenoids
C P	Father drunkard and suicide (subnormal), half brother mentally defective	Infections of upper part of respiratory tract chronic otitis media, infected tonsils and adenoids
S D	Father alcoholic, died of tuberculosis, mother often an inmate of insane asylums	Infections of upper part of respiratory tract, chronic otitis media and sinusitis
J C	Mother apparently subnormal, 5 subnormal siblings by her second husband	Unilateral otitis media, infected tonsils and adenoids
T K	Father dead mother apparently in good health	Epilepsy, chronic otitis media, infections of upper part of respiratory tract
P M	Parents apparently normal	Numerous infections of upper part of respiratory tract chronic otitis media infected tonsils
T B	Father healthy, although nervous mother apparently healthy, of 6 siblings 2 died of syphilis and 1 has club feet paternal grandfather said to be an opium addict	Infections of upper part of respiratory tract, infected tonsils and adenoids, chronic otitis media
W O B	Father alcoholic, 5 feeble-minded siblings, mother apparently healthy	Chronic otitis media, infected tonsils and adenoids, imbecility
W B	No contributory data except that father had a nervous breakdown	Convulsions during teething, usual diseases of childhood, convulsions about once a month at age of 17 many infections of upper part of respiratory tract 2 mastoidectomies, imbecility
C W	Two of 8 children stillborn, 1 died of empyema	Measles, mumps, whooping cough congenital feeble-mindedness, epilepsy, positive Wassermann reaction many infections of upper part of respiratory tract maxillary sinusitis, infection of ethmoid sinuses chronic osteomyelitis, imbecility
R W	Mother supposed to be feeble-minded, 15 siblings, 8 of whom died	Chronically discharging ears infections of upper part of respiratory tract numerous carious teeth ethmoiditis moronity
A B	Father died of chronic alcoholism, mother died of tuberculosis	Maxillary and ethmoid sinusitis numerous infections of upper part of respiratory tract
L S	Father died of cancer, mother apparently healthy	Measles whooping cough infections of upper part of respiratory tract, post nasal infection, infected tonsils and adenoids
G M	Father committed suicide 7 siblings all cared for in institutions and all retarded	

The third tabulation consists of data on 7 patients selected from a private practice and the Montgomery Hospital, Norristown, Pa

Subject	Summary of Case
A M	Twelve years of age, atrophic rhinitis, bilateral purulent mastoiditis
B A	Eight years of age, atrophic rhinitis, bilateral purulent mastoiditis
F B	Female, 24 years of age, purulent pansinusitis (father died of acute toxic dementia following purulent pansinusitis with generalized infection of upper part of respiratory tract, including both tonsils and teeth, brother also had purulent mastoiditis)
M F	Female, 5 years of age, asthma, bronchitis, repeated infections of upper part of respiratory tract, ethmoiditis (father a heavy drinker, mother died of tuberculosis)
F F	Thirty-two years of age, definite bronchial asthma, bronchitis, chronic hyperplasia of nose and throat including tonsils (diabetes in 2 members of family)
F Y	Seventeen years of age, purulent bilateral ethmoiditis, no illness until 16 years of age, 4 plus reaction to Wassermann test, acquired within one year of onset of sinus infection (poor, illiterate parents)
G H	Thirty four years of age, asthma, bronchitis, pansinusitis, bilateral maxillary and ethmoid sinusitis, infection of left middle ear, abscess of lung

Each one of these patients had hyperplasia of the entire upper part of the respiratory tract. They had one thing in common, overgrowth of tissue within the mucosal area of this region. This is associated frequently with imbalance of the autonomic system. The following characteristics in the 7 patients were noticed: familial background of some constitutional or endogenous disease, tuberculosis, diabetes, chronic alcoholism or syphilis, and highly colored (red or dark red), thick mucous membranes with poor neurogenic response. They all seemed to have autonomic imbalance, and they all had similar diseases and symptoms.

In the mechanism of infection or disease of the upper part of the respiratory tract several factors may play a role. For example, endocrines inducing abnormal metabolism of cells in various organs, with insufficient utilization of substances necessary for normal bodily metabolism, may be important. Certain neurogenic factors causing abnormal reactions, particularly within the vascular system, with lack of normal reflex response in the mucous membrane, may be the determining cause. For example, if there is insufficient reflex vascular response in the mucous membrane, there will be a lowered constitutional state, which gives insufficient protection to the subject and exposes him to many types of localized infection. The last-mentioned factor may easily be studied by determining the reaction of the vessels to stimuli, both mechanical and biologic. To this end dermographism in groups of patients was studied, because it is well established that the dermographic response varies according to vasomotor stability. A study of the relations of the two groups was made.

Two tabulations are appended concerning the dermographic tests in the first and the second group. The first, normal, group was tested on Jan 3, 1939.

Subject	Time of Rise, Sec	Width, Mm	Duration (to Fading), Min	Subject	Time of Rise, Sec	Width, Mm	Duration (to Fading), Min
E	3	2.5	2	G	11	3.0	8.6
K	2	3.0	2.5	E	10	4.25	4.5
H	3	3.5	3.5	P	3.5	2.10	2.0
G	6	4.0	3.5	W	6.0	4.00	3.00
F	10	2.75	3.0	P	8.0	3.75	4.00
N	6	3.0	3.5	W	7.0	3.00	4.00
E	8	4.00	3.85	H	6.00	6.0	5.50
W	5	3.5	4.25				

The second group, composed of subjects of abnormal types, was tested on July 25, 1938. The subjects were tested by making dermographic lines on the chest.

Subject	Time of Rise, Sec	Width, Mm	Duration (to Fading), Min	Subject	Time of Rise, Sec	Width, Mm	Duration (to Fading), Min
A K	5	6	12	A B	4	4	4
F W	5	4	8	R W	4	8	Over 30
L T	5	6	12	J D	4	12	Over 30
G L	5	4	7	H W	10	3	13
A D	5	5	10	C W	5	3	6½
L S	5	7	9½	S D	5	12	10
P M	4	8	Over 30	I R	5	10	12
O R	4	7	Over 30				

In the study of dermographism the inmates of the Pennhurst institution, group 2, showed extreme abnormality and an extremely high percentage of pathologic reactions, marked by edema and long persistence of the vascular response of the skin (up to thirty minutes or more). In the other group, from Ursinus College (group 1), the dermographic response was practically of no significance, showing little vascular reaction to mechanical stimulation. It should, however, be emphasized that anomalies of the vasomotor apparatus may be only one of the constitutional factors, further study may reveal many others. Empirically it would appear that patients who show lymphatic hyperplasia with dysfunction of the vegetative system and abnormal vascular and neurogenic responses have not only bad constitutional backgrounds but some form of endogenous constitutional dyscrasia. Of these patients, a consistently high percentage have chronic infection of the upper part of the respiratory tract.

The students of the first group made little if any response to the dermographic tests and the appearance of the mark and the length of time that it remained on the skin were of little significance. Aside from the clinical and empiric observations made with these tests a practical observation also was recorded. In 5 of the subjects in the second group, on whom surgical work aside from tonsillectomy had been done, it was noticed that the end result was poor and the healing delayed. It appears that this procedure might give a good indication of the prognosis for surgical work on patients with low vasomotor stability and poor neurogenic response when purulent infection of the upper part of the respiratory tract is present. In other words, the prognosis for this type of patient may vary with the intensity of the dermographic reaction.

COMMENT

With regard to treatment, little is accomplished unless one can definitely change the constitutional factors in the case. Naturally, when the basic background of the patient is at fault the problem is almost hopeless. However, certain therapeutic measures seem to offer a good deal of benefit. For example, in the field of allergy sometimes a small change in the diet gives great relief of the patient's symptoms. In 1 case, in which a child was drinking a quart of milk a day, the elimination of this food brought about a cessation of the disturbance in the upper part of the respiratory tract, the turbinates became smaller and less edematous, and the cough, undoubtedly an allergic phenomenon, disappeared. In another case, of asthma with bronchitis, 3 minims (0.18 cc) of insulin effected a complete change, undoubtedly because insulin is a hormone to the parasympathetic mechanism and since it apparently regulated the imbalance in the involuntary mechanism it restored the basic equilibrium of the body. It should be remembered also that mild stimulation of the sympathetic nervous system will stimulate the thyroid and correct the lowering of physiologic metabolism incident to endocrine disturbance. This often results in physiologic balance, and symptomatic relief is experienced. Older physicians knew of and spoke about "alteratives." I believe there was truth in their view. Certainly the substances appear to do some good.

Recently potassium chloride in 5 grain (0.32 Gm) doses has been tried with a view to changing the basic bodily reactions. For patients of certain types, it will no doubt do good. The end result to accomplish is physiologic equilibrium. If the autonomic system, the endocrine system or the acid-base metabolism is at fault, one must diagnose the condition and attempt to regulate it physiologically.

SUMMARY

The incidence of infection of the upper part of the respiratory tract in two constitutionally different groups of persons was studied.

Group 1 included average, normally healthy college students.

Group 2 included a cross section of the inmates of a school for persons of low grade mentality.

In addition, a number of private patients were studied.

The difference in the incidence of infection of the upper part of the respiratory tract in the two groups strikingly indicates the variation of the constitutional factor.

In an analysis of this factor, the vasomotor reactions in the two groups were compared by studying the dermographic response.

The dermographic reaction was much more marked and definite in group 2

It is pointed out that abnormal vasomotor reactions may play an important part in the mechanism of infection of the upper part of the respiratory tract

NOTE—Dr McClellan Wilson, of Pennhurst State School, and Dr J Harold Brownback, of Ursinus College, helped with the collection of data and with the dermographic studies of the students from their respective institutions

THE LARYNX OF THE TUBERCULOUS CHILD

HERMAN RUBIN, M D

AND

SAMUEL GALBURT, M D

BROOKLYN

Tuberculosis affecting the larynx of children is not frequently considered. This is so because pulmonary tuberculosis is infrequent in children. Tuberculosis of the larynx of a child is usually discovered during routine examination because the symptoms are frequently not pronounced.

As early as 1806 Laignelet¹ reported the case of a child 12 years of age. Thirty years later Trousseau and Belloc² reported 2 cases and called attention to the rarity of tuberculosis of the larynx before puberty. The statistics of many investigators verify the rarity of this condition. Only 1 of 500 tuberculous larynges examined by Mackenzie³ was that of a child. Of 100 tuberculous patients on whom autopsy was performed, 5 were under 15 years of age. Demme⁴ reported laryngeal involvement in 7 children in 1883. In the same year Froebeli⁵ reported on a series of 16,581 autopsies on children during a ten year period. There were 416 with pulmonary tuberculosis and of these, 10 had ulceration of the larynx. Heinze⁶ found 5 cases of laryngeal involvement in children under 10 years of age in 1,226 autopsies. One child was less than 1 year old. Blumenfeld and Goebel⁷ examined the

From the Otolaryngologic Service of Dr. M. C. Myerson, Sea View Hospital, Staten Island, N. Y.

1 Laignelet, L. F. *Recherches sur la phthisie laryngée*, Thesis, Paris, no 38, vol 61, 1806.

2 Trousseau, A., and Belloc, H. *Traité pratique de la phthisie laryngée*, Paris, J. B. Baillière, 1837, observation XL, p 100, observation LIX, p 150.

3 Mackenzie, M. *Traité pratique des maladies du larynx, du pharynx et de la trachée*, translated by E. J. Moure and F. Bertier, Paris, O. Doin, 1882.

4 Demme, cited by Perrin¹⁸.

5 Froebeli, W. *Ueber die Häufigkeit der Tuberculosis und die hauptsächlichen Localisationen im zartesten Kindesalter*, *Jahrb. f. Kinderh.* **24** 47, 1886.

6 Heinze, O. *Die Kehlkopfsschwindsucht*, Leipzig, Veit u. Comp., 1879.

7 Blumenfeld, F., and Goebel, W. *Ueber die Kehlkopfsschwindsucht bei Kindern*, *Ztschr. f. Laryng., Rhin., Otol.* **23** 267, 1932.

larynges of 89 children suffering with pulmonary tuberculosis. They found 34.8 per cent to be normal. There were questionable lesions in 31.5 per cent and frank ulcerative lesions in 33.7 per cent. These figures are open to question because they are at variance with those of many experienced workers in this field. Lipovetskaya⁸ found laryngeal tuberculosis in 2 of 60 children with the open type of tuberculosis.

At the present time we have 115 children in the pediatric service at the Sea View Hospital. One hundred were examined, and 49 of these had laryngeal changes. Of these 49, 30 had tubercle bacilli in their sputum, or feces or gastric contents.

The patient in the case reported by Nobecourt and Tixier⁹ in 1909 is the youngest one on record, an infant 3½ months old. On post-mortem examination the larynx was found to contain granulation tissue and ulcerations.

Various reasons are given for the relative infrequency of this condition. Murano¹⁰ expressed the belief that the lymphatic ring of Waldeyer exerts a protective influence. Barthez and Sanne¹¹ stated that the symptoms are not noticed early because of their mildness. Later, in the majority of cases they are overshadowed by the general complaints, which appear to be more important. Hoarseness and dysphagia may appear just before death. In this connection Myerson¹² called attention to the fact that there is frequently a hematogenous spread of the disease to the larynx and other viscera shortly before death. For this reason postmortem observations in the larynx are not always reliable or dependable. Barthez and Sanne¹¹ mentioned that the child's larynx is not exposed to abuses which frequently cause chronic laryngitis such as alcohol, tobacco and dust, as in the occupations.

The method of production of the laryngeal infection is discussed by many authors. Louis¹³ was first to ascribe infection of the larynx to the sputum. Similar observations were made by Gouguenheim and

8 Lipovetskaya, E. N. Laryngeal and Pharyngeal Tuberculosis in Children, *Probl. tuberk.*, 1936, pp. 1569-1570.

9 Nobecourt, P., and Tixier, L. Tuberculose du larynx chez un enfant de 3½ mois, *Bull. Soc. de pediat. de Paris* **11**, 368, 1909.

10 Murano, G. Su due casi di tubercolosi laringea, *Pediatrics* **43**, 1254, 1935.

11 Rilliet, F., and Barthez, E. *Traite clinique et pratique des maladies des enfants*, ed. 3, revised by E. Barthez and A. Sanne, Paris, F. A'can, 1891.

12 Myerson, M. C. Tuberculosis of the Larynx, *Quart. Bull., Sea View Hosp.* **4**, 127, 1938.

13 Louis, P. C. A. *Recherches anatomico-pathologiques sur la phthisie*, Paris, Gabon & Cie, 1825.

Tissier,¹⁴ Fraenkel¹⁵ and others. Infections by way of the blood vessels and lymphatics were first described by Isambert¹⁶ in 1874. Catti¹⁷ and others also expressed the opinion that infections occur in this manner. Direct invasion of the laryngeal mucosa by the organisms carried in inspired dust was mentioned by Perrin¹⁸ as the causative factor in his case.

The methods of infection may be listed in their order of frequency as follows: (1) by way of the lymphatics from the primary pulmonary lesion, (2) by direct contact with the bacilli-laden sputum, (3) through the blood stream, as in miliary infections, and (4) by direct extension from a primary pharyngeal lesion.

The pathologic process of tuberculosis has recently been discussed by Myerson.¹²

None of our patients had a laryngeal lesion at the same time as the primary complex.

The possibility of infection of the larynx from tuberculosis of the tonsils and adenoids must be considered.

In several of our patients in whom the pulmonary lesion was either of the arrested or of the glandular type the tonsils and adenoids were removed and on section proved to be tuberculous. Infection occurring through the lymphatics or submucosal tissue must be considered. It is well known that streptococcic infections of the larynx are not infrequently secondary to tonsillar or peritonsillar inflammation and are due to direct extension.

Laryngeal involvement occurs more often with the caseous pneumonic type of pulmonary tuberculosis than with any other type of lesion. Since the sputum is positive more often in this than in any of the other types of infection, involvement of the larynx by direct contact with infected sputum must be considered as the most frequent mechanism of infection.

SYMPTOMATOLOGY

We were impressed by the lack of symptoms in many of the children examined by us. Some were so mild that one would hardly expect to

14 Gouguenheim, A., and Tissier, P. *Phthisie laryngée*, Paris, G. Masson, 1889.

15 Fraenkel, E. *Untersuchungen über die Aetiologie der Kehlkopfgeschwüre*, Virchows Arch f path Anat **121** 523, 1890.

16 Isambert. *De la tuberculose miliaire aigue pharyngo-laryngée phthisie aigue pharyngo-laryngée*, read before la Société médicale des hôpitaux de Paris, April 10, 1874, Conference clinique sur les maladies du larynx et des premières voies, Paris, G. Masson, 1877.

17 Catti, G. *Der pharyngo-laryngeale Typhus der acuten Miliartuberkulose*, Wien klin Wchnschr **7**.438, 1894.

18 Perrin, M. *La tuberculose du larynx dans l'enfance*, Rev hebdomadaire de laryng **1** 65 and 338, 1902.

find definite or extensive changes in the larynx. The symptoms varied from a slight huskiness to hoarseness and aphonia. A sense of soreness in the throat and a slight dysphagia were occasionally complained of. None of the severe symptoms usually seen in the adult larynx were found.

EXAMINATION

We were able to make all of the examinations by the indirect laryngoscopic method. Ten children were not included in this series because we could not examine them with the mirror. Direct laryngoscopic examination was not employed for any of these children. The lesion most frequently seen is a redness or hyperemia. This may occur in any part of the larynx but is most frequently seen in the region of the arytenoid cartilage, the posterior commissure and the posterior half of the true cord. Infiltration of one or of both cords has occasionally been seen. Granulations, edema, ulceration and perichondritis are rarer findings. One of our patients who was examined at autopsy had extensive ulceration on the epiglottis and vocal cords. Necrosis of the cricoid cartilage has been described by Bar.¹⁹ Infiltration of the area of the posterior commissure and of the ventricular bands has been seen several times. The rarest form is the acute miliary type first described by Isambert. The vocal cords of 2 of our patients were studded with fine pinpoint lesions. One patient had a positive Wassermann reaction and the other a positive Kahn reaction. Biopsy was not performed in either case. The possibility of such a lesion being a benign form of miliary lesion in the larynx must be considered.

Only 4 of the 100 tuberculous children were referred for a laryngologic examination because of persistent hoarseness or dysphagia. The remaining 96 were subjected to a routine examination of the larynx regardless of the presence or absence of symptoms.

The children were between 3 and 15 years of age. Forty-nine per cent of them presented some evidence of involvement of the larynx.

An analysis of the laryngeal lesions of these children revealed that the posterior commissure and the arytenoid cartilage were most frequently involved. The most common lesion was hyperemia, which was either localized to one of the structures or involved the entire larynx. The next most common lesion was infiltration. Other local manifestations of the disease in their order of frequency were ulceration, edema and tuberculoma.

Hyperemia of some part of the laryngeal mucosa is usually the earliest sign of laryngeal tuberculosis in children. Edema is occasionally seen as the first lesion. We have seen it more often in adults than in children. It is considered as an allergic manifestation to the bacillary proteins.

¹⁹ Bar, L. De la laryngite oedemateuse chez les enfants, Arch. internat. de laryng., d'otol., de rhin. 9 354, 1896.

The distribution of the lesions in the 49 positive larynges was as follows

		No of Patients
1	Hyperemia of the entire larynx	7
2	Interarytenoid space	{ Hyperemia 15
		{ Infiltration 7
		{ Tuberculoma 1
		{ Ulceration 1
3	Arytenoid cartilages	
	(a) Right	Edema 1
	(b) Both	{ Hyperemia 6
		{ Infiltration 3
		{ Edema 3
4	Vocal cords	
	(a) Right	{ Papilloma 1
		{ Miliary Tuberculosis 1
	(b) Left	Ulceration 1
	(c) Both	{ Hyperemia 8
		{ Infiltration 4
		{ Edema 1
		{ Ulceration 1
		{ Miliary Tuberculosis 1
5	Ventricular bands	
	(a) Right	Ulceration 1
	(b) Both	{ Edema 1
		{ Ulceration 1

In the group of patients with infiltrative pulmonary tuberculosis there were 7 with laryngeal changes, in 5 of whom they consisted of hyperemia. The sputum of all of the group with laryngeal changes was negative. One had a positive gastric content. The greater number with positive evidence of tubercle bacilli occurred in the group without laryngeal involvement. Of the 6 patients in this group, 1 had a positive sputum and 3 a positive gastric content.

Of the 22 with exudative pulmonary lesions, there were 8 with involved larynges. The sputum of all these children was negative and the gastric contents of 1 were positive, this child had a hyperemic lesion of the larynx. The findings for the remaining children in this group in regard to sputum, gastric contents and feces were negative.

Of the group of 43 with caseous pneumonic tuberculosis, 30 had laryngeal involvement. Of these, 18 had positive sputum, 5 had positive gastric contents and 2 had positive feces. The lesion in 17 of the patients consisted of hyperemia. Nine of these had positive sputum and 3 had

positive gastric contents. Tubercle bacilli in the sputum, gastric contents and feces seem to occur with the same frequency irrespective of whether the lesions are minimal or far advanced when the pulmonary tuberculosis is of the caseous pneumonic type.

Most of our children with exudative and infiltrative types of tuberculosis and a small percentage of the others had no tubercle bacilli in the sputum, gastric and fecal contents. A direct examination of the secretion from the lobe bronchus is frequently positive in these cases. This can be obtained by bronchoscopic examination, which might reveal a tracheobronchial lesion or the presence of considerable secretion coming from a lobe bronchus. A 14 year old white girl had a caseous pneumonic lesion of the upper lobe of her left lung. The sputum was persistently negative and the gastric content occasionally positive. After pneumothorax, the gastric content still remained positive. Bronchoscopic examination revealed a granular appearance of the trachea and

Incidence and Relation of Laryngeal Involvement to Pulmonary Involvement

Pulmonary Findings	Number of Patients	Number with Laryngeal Lesions	Hyperemia of Larynx	Other Lesions	Positive Sputum	Positive Gastric Contents	Positive Feces
Caseous pneumonia	43	30	17	13	30	7	3
Exudative	22	8	5	3	0	1	
Infiltration	13	7	5	2	1	4	
Mediastinal glands	12	0	0	0	0	0	0
Pleural effusion	10	4	1	3	0	0	0

the left main bronchus and the opening to the upper lobe of the left lung. A considerable amount of exudate came from this lobe. Direct examination of a smear showed a high number of tubercle bacilli on the basis of the Gaffky scale.

There were 54 children in whom the examination of the sputum, gastric contents and feces failed to show the presence of tubercle bacilli. Laryngeal changes were found in 23 (42 per cent). Their lesions were as follows: hyperemia, 14; edema, 4; thickening of the vocal cords, 3; infiltration of the posterior commissure, 1; and other lesions, 1.

Of the 46 children with positive findings for tubercle bacilli in the sputum, gastric contents or feces, 25 had laryngeal lesions (54 per cent). In this group there was a greater incidence of laryngeal involvement.

A pleural effusion associated with no other demonstrable pulmonary pathologic process at the present time was found in 10 children.

There were no positive findings in the sputum, gastric contents and feces of all these children.

TREATMENT

The treatment of tuberculous laryngitis in children consists chiefly of vocal rest. We also use instillations of halibut liver oil or cod liver oil and ultraviolet irradiation (Kromayer lamp) directed into the larynx by means of a special quartz applicator. The galvanocautery is used early in the treatment of patients with nonacute superficial and deep ulcerations, edema and tuberculomas. Edematous swellings and tuberculomas are treated by puncture, while the ulcerations are superficially seared. For older children we are able to use the cautery by means of indirect laryngoscopic inspection. Laryngeal pain is controlled by injection into the superior laryngeal nerve or by the use of a spray containing 1 per cent solution of cocaine hydrochloride.

Many chemical applications and special therapeutic measures have been advocated from time to time. The existence of so large a number indicates their lack of real value.

The prognosis is unfavorable when a child has a laryngeal complication with pulmonary tuberculosis. It is not hopeless, however, as was formerly believed. The progress of the laryngeal condition usually keeps pace with that in the chest. Improvement and recovery can and do occur. One of our children has a completely healed larynx, despite the fact that the sputum has remained positive and further surgical treatment of the chest will be necessary. Most of the children with extensive pulmonary lesions, however, succumb before the throat has healed. The employment of collapse therapy has undoubtedly improved the prognosis. Blumenfeld and Goebel⁷ have reported a reduction in the mortality from 90 to 50 per cent after the use of collapse procedures.

SUMMARY

Relatively few children are referred by the pediatrician for laryngeal examination because the early local symptoms are mild and are overshadowed by the constitutional signs. Routine examination of the larynx of all children with pulmonary tuberculosis should be done. Such examination would disclose a larger number with laryngeal involvement. The child's larynx is not exposed to as many irritating factors as that of the adult.

Indirect laryngeal examinations were carried out on 100 tuberculous children and a large number of lesions were found. Hyperemia and infiltration were the most common findings. These were seen most often in the posterior commissure. The greatest number of lesions were found in the group with caseous pneumonic tuberculosis, and the sputum of these children was most often found to be positive. Changes in the larynx were found in 23 of 54 children with tuberculosis whose

sputum, gastric contents and feces were negative. There were 21 normal larynges found among 46 children whose sputum, gastric contents or feces were positive.

Bronchoscopic examination should be performed on tuberculous children who have negative sputums, because a direct smear will often show the presence of tubercle bacilli. It is contraindicated when active laryngeal lesions exist.

The chief therapeutic measures are vocal rest and the application of the galvanocautery electrode. The general and pulmonary condition must also be treated. Collapse therapy has greatly improved the local condition and the general prognosis.

Case Reports

RECOVERY FROM THROMBOSIS OF THE CAVERNOUS SINUS

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The extreme rarity of a recovery from thrombosis of the cavernous sinus, in addition to the administration of an unusually large amount of sulfanilamide seems sufficient reason for this case report

REPORT OF A CASE

Mrs. S., aged 19, white, had a history of intermittent suppurative otitis media in the left ear which had followed an attack of scarlet fever during early childhood. I was asked to examine her in her home on Dec. 14, 1938. She was complaining of severe pain in and around her left ear and the left side of her head and neck. According to the patient's mother, her present illness had begun about two weeks previously with an attack of influenza and tonsillitis. During the first days she had had a chill and intermittent chilly sensations followed by fever. On examination I found copious discharge of thick yellow pus from the left ear. There was no drooping of the canal wall and no tenderness or edema over the mastoid process. The right ear and mastoid were normal. She also had a bilateral purulent nasal discharge, and both tonsils were enlarged and inflamed. The lymph glands in the region of the angle of the left jaw were enlarged considerably and tender to the touch. The temperature was 100 F. The patient's general appearance was that of a very sick person. A thorough examination in the home being impossible, it was advised that she be taken to the hospital or my office for further examination. I heard nothing more from the family until five days later, when the mother informed me that her daughter's general condition was much worse and that both her eyes were badly swollen. She was then brought to the hospital.

On admission it was found that the patient had a high degree of proptosis of both eyes, accompanied by chemosis of the conjunctivas. The proptosis of the left eye was so marked that the lids could not cover the eye. The swelling at the angle of the left jaw had increased considerably. The patient complained of severe generalized intermittent headache which was most intense over the right frontal region and was worse at night. The temperature was 102.6 F., but there was no repetition of chills or chilly sensations. There was a copious discharge from the left ear but no drooping of the canal wall, pain on pressure or edema over the left mastoid area.

A diagnosis of thrombosis of the cavernous sinus was made, the usual prognosis was anticipated, and no hope for recovery was given to the family. It was surmised that thrombosis of the lateral sinus existed on the left side and had extended to the jugular bulb and vein and also through the petrosal sinuses to the cavernous sinus, which had become involved. Because a diagnosis of thrombosis of the cavernous sinus had been made and the patient's general condition was poor, surgical intervention on the mastoid did not seem to offer any hope and so was not resorted to until later. Hemolytic streptococci were found in a culture of material taken from the ear.

Therapy—Sulfanilamide, 20 grains (1.29 Gm.) and later 15 grains (0.97 Gm.) was given every four hours. The patient was also given 60 cc. of a polyvalent

antistreptococcus serum during the first three days in the hospital, and in addition blood transfusions of 500 cc each were given on the third, the sixth, the sixteenth and the forty-fourth day

Course—The swelling at the angle of the jaw increased in size rapidly, owing to an enlargement of the cervical glands and also to edema and cellulitis. The left wall of the throat and the tonsil were dislocated to the right until the patient had great difficulty in breathing. On December 22, four days after her admission to the hospital, an incision was made into the edematous peritonsillar area, but no pus was found. After several days the edema of the neck and throat began gradually to subside. The glandular swelling remained until after the operation on the mastoid. The patient's general condition improved remarkably during the first week in the hospital. The proptosis in the left eye and the edema and swelling in the throat improved, and the temperature became less septic. In other words, the entire septic picture showed definite improvement, and consequently the operation on the mastoid was postponed for fear that it might cause another exacerbation of the general septic condition.

Finally, on Jan 3, 1939, fifteen days after her admission, a radical operation was performed on the left mastoid. The cortex was sclerotic, but considerable destruction of bone and pus was found in the region of the antrum and around the sigmoid sinus. The sinus was opened and found to contain an organized clot, which did not seem to be infected. No attempt was made to remove the clot or to ligate the jugular vein. After the operation the swelling in the neck subsided rather rapidly.

On January 12, nine days after the operation on the mastoid, severe pain developed in the right eye and over the entire right side of the head, with an increase of the proptosis and chemosis of the right eye. A tumefaction gradually developed in the conjunctiva of the lower part of the fornix, pushing the eyeball upward and outward. On January 27, sixteen days after the tumefaction began, it was incised and a large quantity of pus evacuated, with immediate relief. After the evacuation of the orbital infection the patient's general and local condition improved rapidly. She was able to leave the hospital on February 11, having been hospitalized for fifty-five days.

A few days after the patient's return home an excruciating pain in the right eye again developed, with extreme proptosis. At this time a corneal ulcer developed, and for several days panophthalmitis threatened, but after drainage of the orbital infection the entire inflammatory process subsided, and at the time of writing the vision in this eye is only slightly impaired.

The patient's blood picture during her illness was as follows. On admission, the erythrocyte count was 3,700,000, with 73 per cent hemoglobin, and the leukocyte count was 36,000. The highest leukocyte count was 39,000. The lowest blood count recorded was shortly before she left the hospital, i e, red cells, 2,960,000, with 48 per cent hemoglobin, and white cells 8,300.

The temperature was 102.2 F on admission. It rose as high as 104 F. After the first week it rose to 101 F on one occasion only. There was practically no fever after the second week.

Administration of Sulfanilamide—The patient received sulfanilamide at four hour intervals during thirty-six days of her stay in the hospital. The total amount given during the period was 2,230 grains (144.5 Gm.)

First National Bank Building

TREATMENT OF MENINGITIS DUE TO PNEUMOCOCCUS TYPE III WITH SULFANILAMIDE, RECOVERY

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Acute meningitis is one of the most dramatic of all the infections of the nervous system in its sudden onset and rapid progress. Except for meningitides due to the meningococcus and a few other agents, the outlook for the preservation of life is usually poor. The prognosis is particularly unfavorable for pneumococcal meningitis, and a fatal termination has almost invariably occurred. In this paper a case of meningitis due to the type III pneumococcus in which recovery, presumably due to sulfanilamide therapy, occurred is reported. The patient remained well four months after recovery and then died of a disease related to hypertension. The experience at the Philadelphia General Hospital with meningitis due to *Pneumococcus* type III is reviewed, as are certain aspects of the literature.

REPORT OF A CASE

B. M., a 47 year old Negress, was admitted to the Philadelphia General Hospital, service of Dr. J. C. Yaskin, on May 8, 1938. She had been brought by a friend, who had found her in a generalized clonic convulsion, which was followed by wild, purposeless movements. The patient was delirious on admission, did not recognize her friends and apparently could not speak. The history obtained later from her relatives revealed that nine days before admission she had had a "cold," followed by pain in the right ear. A discharge of pus from the right ear had been noticed on May 5. Disturbances of consciousness and convulsions had not appeared until the day of admission.

In 1925 and 1926 she had received a full course of antisyphilitic therapy. Since 1932 she had been admitted to the hospital on three different occasions for diabetic acidosis. There was a history of chronic alcoholism and of intermittent trouble with the ears.

On admission the patient was restless and did not respond effectively to stimuli. She was moderately well nourished, although obviously acutely ill and febrile. She flung her arms and legs about purposelessly. Her blood pressure was 230 systolic and 166 diastolic, and her heart was enlarged to the left. There was a purulent discharge from the right ear. Nuchal rigidity was marked, and the Kernig and Brudzinski signs were present. The tendon reflexes were all active. During the examination right-sided jacksonian convulsions were noted. There was no Babinski sign. A spinal tap done at this time released cloudy fluid, the pressure of which was 10 mm. of mercury.

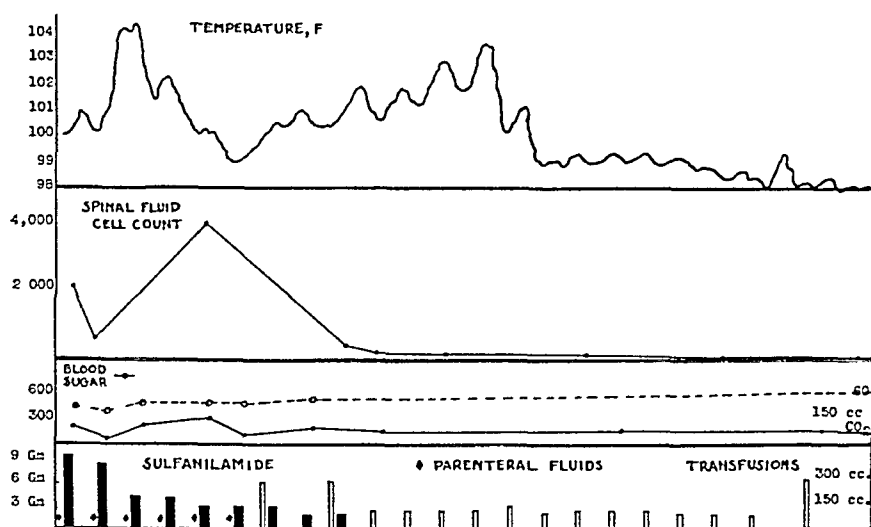
The spinal fluid on May 8 contained 2,100 cells, of which 95 per cent were polymorphonuclear, and a pure culture of *Pneumococcus* type III was grown. The Wassermann reaction of the spinal fluid was negative. Examinations of the blood yielded the following data: sugar content, 244 mg. per hundred cubic centimeters, carbon dioxide-combining power, 44 volumes per cent, urea nitrogen

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content, 8 mg per hundred cubic centimeters, culture, sterile. The blood count showed 3,900,000 erythrocytes, with 10 Gm of hemoglobin and 14,800 leukocytes, of which 97 per cent were polymorphonuclear cells. The urine contained sugar.

The diabetes mellitus was treated by Drs E S Dillon and W W Dyer, at first with intravenous administration of dextrose in a saline solution and insulin and later with a diabetic diet given through a nasal tube. No great difficulty was encountered in controlling the diabetes at that time. During the first twenty-four hours the patient was given 9.3 Gm of sulfanilamide, the next day, 8 Gm, the third day, 4 Gm, the fifth, sixth and seventh days, 3 Gm, and on the eighth day, 2 Gm.

The patient was too ill to be moved so that roentgenograms could be made of the region of the mastoid, which was evidently the source of the meningeal infection. The otologist considered her such a poor surgical risk that operative intervention was not justified. On May 12 she appeared somewhat better but had 4,000 cells in her spinal fluid. Clinical improvement continued, and on May 16



Clinical course of patient

culture of the spinal fluid was negative and the cell count reduced to 390. However, the patient then had right hemiparesis, and a roentgenogram taken at that time showed evidence of right-sided mastoiditis. Since the hemoglobin content had fallen to 9.5 Gm as a result of the disease and of the sulfanilamide therapy combined, several blood transfusions were given. Clinical improvement from then on was rapid, the patient became cooperative, the temperature returned to normal, and the ear drum healed and resumed a normal color and contour. Repeated cultures of the spinal fluid revealed no organisms, and the cells gradually disappeared. The only sequelae which remained four months after the onset were right monoplegia brachialis and aphasia. The treatment for diabetes was standardized at 30 units of protamine zinc insulin daily with a controlled diet. The patient remained in the neurologic ward as an ambulatory patient.

She continued to be well until the morning of September 20, when she felt ill and stayed in bed. Examination revealed moderate nuchal rigidity and inflammation of the right ear drum. The spinal fluid pressure was normal and the fluid turbid, containing 1,640 cells, of which 67 per cent were polymorphonuclear. The leukocyte count for the blood was 26,000, with 98 per cent polymorphonuclear cells.

The sugar content of the blood was 520 mg per hundred cubic centimeters and the carbon dioxide-combining power 31 volumes per cent. The patient rapidly became stuporous and was comatose by afternoon, when she had a series of generalized convulsions. She was treated for diabetic acidosis, and the next morning (September 21) the sugar content of the blood was 67 mg per hundred cubic centimeters and the carbon dioxide-combining power 70 volumes per cent. She was given sulfanilamide, 8 Gm the first day, 6 Gm the second and the third day, 3 Gm daily from the fourth to the eleventh day and 2 Gm daily for the last two days of her life. For a few days she showed symptomatic improvement. Culture of material removed from the right ear after myringotomy revealed type III pneumococci, and roentgenograms of the region of the mastoid showed evidence of mastoiditis on the right. The cell content of the spinal fluid decreased to 610, then to 83 and on the last day of her life to 70. At no time during this period were organisms found in the spinal fluid. The patient became moribund suddenly on September 30. The sugar content of the blood, which had steadily been climbing, was 520 mg per hundred cubic centimeters, and the carbon dioxide-combining power was 37 volumes per cent. Diabetic acidosis and coma progressed until death, despite massive doses of insulin.

Postmortem examination (Drs K. M. Corrin and H. E. Riggs) revealed arteriosclerotic cardiovascular disease with some passive congestion. The brain showed marked fibrosis of the arachnoid throughout, a fairly large area of softening in the left temporal lobe and many smaller areas of softening in the hemispheres and brain stem. Acute inflammatory reaction of the meninges was not observed on gross or microscopic examination. The right mastoid cells were necrotic. The pancreas showed severe atrophy and fibrosis, with dilatation of the ducts. Some pancreatic calculi also were present. Nephrosclerotic disease was moderate to marked.

This case is of interest from several points of view. With a background of diabetes mellitus, hypertensive disease and alcoholism, the patient's chances for recovery from pneumococcal meningitis seemed extremely poor. She was desperately ill on admission, and in the face of this situation the treatment consisted solely of administration of sulfanilamide and control of the diabetes. We feel that recovery would not have occurred but for this therapy. The residuum of aphasia and hemiparesis was evidently due to the area of softening in the left hemisphere.

The acute clinical meningeal reaction which preceded death (from diabetic acidosis) might have been occasioned by the leakage of necrotic material from the area of softening into the subarachnoid space. The absence of any organism in the spinal fluid during this terminal episode and the lack of postmortem evidence of acute inflammatory meningitis make reinfection as a cause of the terminal episode unlikely.

GENERAL COMMENT

In the wards of the Philadelphia General Hospital from Jan. 1, 1936, to Aug. 1, 1938, 130 cases of acute meningitis were observed. In 40 of these, or 30.8 per cent, the cause was the pneumococcus, and in 12 of these cases the organism was of type III. In 10 of the 12 cases the origin was otitic, and in all except that here reported acute meningitis caused death. In 4 cases other than that here reported treatment was with sulfanilamide. In 1 the dose was inadequate—3 Gm in twenty-

four hours. In the second intensive treatment with sulfanilamide, prontosil¹ and drainage of spinal fluid was instituted. The patient lived eight days and died with the spinal fluid too thick to drain. In the third meningitis developed one month after mastoidectomy, and the patient died after a week of therapy with sulfanilamide. In the fourth the patient received sulfanilamide, improved and was submitted to mastoidectomy and craniotomy, at which an extradural abscess was found. Administration of sulfanilamide was continued, and the cell count of the spinal fluid was reduced, but death occurred from cerebral edema. Each of the last 3 patients lived longer than those not treated with sulfanilamide.

Data on Cases of Meningitis Due to the Type III Pneumococcus in the Philadelphia General Hospital from Jan. 1, 1936, to Aug. 1, 1938

Race	Sex	Age	Source	Complications	Blood Culture	Cell Count or Condition of Spinal Fluid	Days in Hospital	Treatment
W	M	56	Otitis			Purulent	1	None
W	F	60	Otitis		Positive	2,700	1	None
N	M	37	Otitis			Purulent	3	None
N	F	50	Otitis	Diabetes	Positive	15,500	2	None
N	M	52	Pneumonia			700	2	None
W	F	28	Otitis			2,500	1	None
W	M	55	Endocarditis	Alcoholism		2,500	1	None
W	M	20	Otitis		Positive	18,000	8	Administration of sulfanilamide and prontosil ¹
W	M	56	Otitis	Echinococcal cyst of liver		6,400	2	Administration of sulfanilamide
N	F	49	Otitis		Positive	500	92	Mastoidectomy, administration of sulfanilamide
W	F	33	Otitis		Negative	4,240	13	Mastoidectomy, administration of sulfanilamide
N	F	47	Otitis	Diabetes, hypertension, alcoholism	Negative	4,000	147	Administration of sulfanilamide

We have found reported in the literature only 8 recoveries from meningitis proved to be due to the type III pneumococcus. In the first case² the patient received successively antimeningococcic serum, anti-pneumococcic serum and ethylhydrocupreine hydrochloride administered intrathecally and daily drainage of spinal fluid. The authors expressed the belief that the ethylhydrocupreine hydrochloride had specific therapeutic value. In the case reported by Weinberg³ recovery followed

1 The disodium salt of 4-sulfamidophenyl-2'-azo-7'-acetvlamino-1'-hydroxynaphthalene-3', 6'-disulfonic acid. This is the substance previously known as prontosil soluble and now to be called neoprontosil.

2 Ratnoff, H. L., and Litvak, A. M. Pneumococcus Meningitis Treated with Morgenroth's Optochin Hydrochloride. *Arch. Pediat.* **43**: 466, 1926.

3 Weinberg, M. H. Case of Pneumococcus (Type III) Meningitis Treated with Potassium Permanganate, Recovery. *J. Nerv. & Ment. Dis.* **74**: 38, 1931.

enemas of potassium permanganate. In Cavenagh's case⁴ recovery occurred without any specific therapy. In the case reported by Steinholtz and Gleich⁵ treatment was with nonspecific serum administered intrathecally, in this case the organism was shown experimentally to have been attenuated. The case reported by Tripoli⁶ was one of primary meningitis occurring six days after spinal puncture for anesthesia, treatment was with nonspecific serum administered intrathecally and drainage of lumbar and cisternal spaces. Allman⁷ reported the case of a 15 year old girl who recovered after mastoidectomy. Two cases of meningitis due to the type III pneumococcus in which recovery occurred after the use of sulfanilamide have been reported. In Gubner's case⁸ a 5½ year old boy in whom meningitis followed mastoidectomy was treated by sulfanilamide, transfusions and reopening of the mastoid wound. In the case of Finland, Brown and Rauh⁹ a 10 year old boy recovered after treatment with sulfanilamide, mastoidectomy and auto-serum administered intrathecally.

The action of sulfanilamide against the type III pneumococcus has been demonstrated experimentally and clinically. Rosenthal showed its effectiveness in high dilutions in vitro¹⁰ and in protecting mice¹¹ and rabbits¹² from lethal intraperitoneal inoculations. Cooper and his associates have also shown that sulfanilamide administered orally is curative against infections with the type III pneumococcus in mice¹³ and against experimental pneumonia in rats¹⁴. Clinically, excellent results against pneumonia due to the type III pneumococcus have been reported by

4 Cavenagh, J. B. Recovery from Pneumococcal Meningitis, *J. Laryng & Otol* **48** 337, 1933

5 Steinholtz, R., and Gleich, M. Pneumococcus (Type III) Meningitis, Recovery, *J. A. M. A.* **105**:795 (Sept 7) 1935

6 Tripoli, C. J. Bacterial Meningitis Comparative Study of Various Therapeutic Measures, *J. A. M. A.* **106** 171 (Jan 18) 1936

7 Allman, C. M. Meningitis Due to the Type III Pneumococcus. Review of the Literature and Report of a Case of Otitic Origin with Recovery Following Radical Mastoidectomy and Labyrinthectomy, *Arch. Otolaryng.* **25** 653 (June) 1937

8 Gubner, J. Recovery of a Patient with Type III Pneumococcus Meningitis of Otitic Origin, *Arch. Otolaryng.* **28**:241 (Aug.) 1938

9 Finland, M., Brown, J., and Rauh, A. Treatment of Pneumococcal Meningitis, *New England J. Med.* **218** 1033, 1938

10 Rosenthal, S. M. The Effect of *p*-Aminobenzene Sulphonamide on Pneumococci in Vitro, *Pub. Health Rep.* **52** 192, 1937

11 Rosenthal, S. M. Chemotherapy of Experimental Pneumococcus Infections, *Pub. Health Rep.* **52** 48, 1937

12 Rosenthal, S. M., Bauer, H., and Branham, S. E. Comparative Studies of Sulphonamide Compounds in Experimental Pneumococcus, Streptococcus and Meningococcus Infections, *Pub. Health Rep.* **52** 662, 1937

13 Cooper, F. B., Gross, P., and Mellon, R. R. Action of *p*-Aminobenzenesulfonamide on Type III Pneumococcus Infections in Mice, *Proc. Soc. Exper. Biol. & Med.* **36** 148, 1937

14 Gross, P., and Cooper, F. B. Efficacy of *p*-Aminobenzenesulfonamide in Experimental Type III Pneumococcus Pneumonia of Rats, *Proc. Soc. Exper. Biol. & Med.* **36** 225, 1937

Louis,¹⁵ Millet¹⁶ and Heintzelman, Hadley and Mellon¹⁷ Since the drug is easily absorbed from the gastrointestinal tract and appears in a comparatively short time in the spinal fluid in but slightly less concentration than in the blood,¹⁸ it seems that the oral route of administration of sulfanilamide is adequate for the treatment of meningitis. From our limited experience in the cases here reviewed, sulfanilamide appears effective against some meningeal infections due to the type III pneumococcus, as it is against infections with this organism elsewhere.

SUMMARY AND CONCLUSIONS

Meningitis due to the type III pneumococcus is extraordinarily lethal. The recoveries we have found reported in the literature total 8, of which the latest 2 followed treatment with sulfanilamide and operative procedures directed against the primary focus of infection. In the case reported here the patient's desperate condition prevented the otologist from performing mastoidectomy, so that her recovery from the acute meningitis, we feel, was due solely to the action of sulfanilamide. The fact that the prognosis was made so unfavorable by the complicating systemic conditions, marked hypertension and diabetes and chronic alcoholism, makes a more than ordinarily strong argument in favor of hope from the use of sulfanilamide against meningitis due to the type III pneumococcus.

15 Louis, D. J. Treatment of Pneumonias with Sulphanilamide, Illinois M. J. **73** 422, 1938.

16 Millet, J. The Action of Sulfanilamide in a Case of Type III Pneumococcus Pneumonia, New York State J. Med. **37** 1743, 1937.

17 Heintzelman, J. A. L., Hadley, P. B., and Mellon, R. R. Use of *p*-Aminobenzenesulfonamide in Type III Pneumococcus Pneumonia, Am. J. M. Sc. **193** 759, 1937.

18 Marshall, E. K., Emerson, K., Jr., and Cutting, W. C. Para-Aminobenzenesulfonamide—Absorption and Excretion. Method of Determination in Urine and Blood, J. A. M. A. **108** 951 (March 20) 1937.

New Instruments

SIMPLIFIED APPARATUS FOR LARYNGEAL CINEMATOGRAPHY

ADRIAN SOLO, M D, SOMERVILLE, MASS, AND NATHAN L FINEBERG, M D,
AND GEORGE LEVENE, M D, BOSTON

The apparatus herein described embodies two unique features (1) simplicity and (2) construction from standard equipment

The camera is a "filmo 8," using 8 mm film It is equipped with a Taylor-Hobson F 25 universal focus lens opened to its widest aperture The focal image obtained at a short working distance, which in our case is $10\frac{1}{4}$ inches (26 cm), is sharpened by the addition of a front lens The source of light consists of three 4 watt bronchoscopic bulbs, of which one is carried in its usual channel and the other two are carried in a holder which clips onto the laryngoscope

A connecting brass tube is made to fit snugly onto the sleeve of the camera lens (A) by a tight sliding joint (fig 1) The other end of this tube is threaded to receive a no 3 Leica (F 35) front lens (B) Attached to the collar of the front lens by a tight, sliding fit is a brass tube (C) $5\frac{1}{2}$ inches (14 cm) long, the caliber of which permits it to slide into the lumen of the 16 mm Pilling laryngoscope The tube is inserted to a marked point so that the front of the lens (B) is $9\frac{1}{4}$ inches (23.5 cm) from the tip of the laryngoscope This affords a depth of focus of 1 to $1\frac{1}{2}$ inches (2.5 to 3.8 cm) ahead of the laryngoscope The extension tube (C) has a light-tight collar (D) covering a series of breathing holes (E), which assist breathing and reduce condensation of moisture on the front lens

The apparatus is used as follows The camera is loaded with Eastman panchromatic film and set to run at 10 frames a second Tube C is inserted into the laryngoscope to its proper distance The clip carrying the two extra bulbs is snapped into position and the laryngoscope introduced The front lens adapter and front lens (as a single unit) are wrapped in a hot-water bottle to bring the lens to body temperature The adapter, being turned out of solid brass, will hold heat sufficiently long to permit exposure of 8 to 10 feet (2.4 to 3.3 meters) of 8 mm film The adapter and lens are slipped over the lens of the camera and the whole assembly connected to the extension tube (which is already in position in the laryngoscope) by a tight sliding joint By careful machining the parts are made to fit snugly, so that the entire assembly is rigid as a single unit and automatically aligned Good pictures may be obtained unless the patient moves considerably

The pictures in figure 2 were obtained with the apparatus described, using Eastman panchromatic film, which has a Mazda Weston rating of 6 Better results have since been obtained by using "Kodachrome A," which has a Mazda Weston rating of 12

From the Departments of Otolaryngology and Radiology, Massachusetts Memorial Hospitals

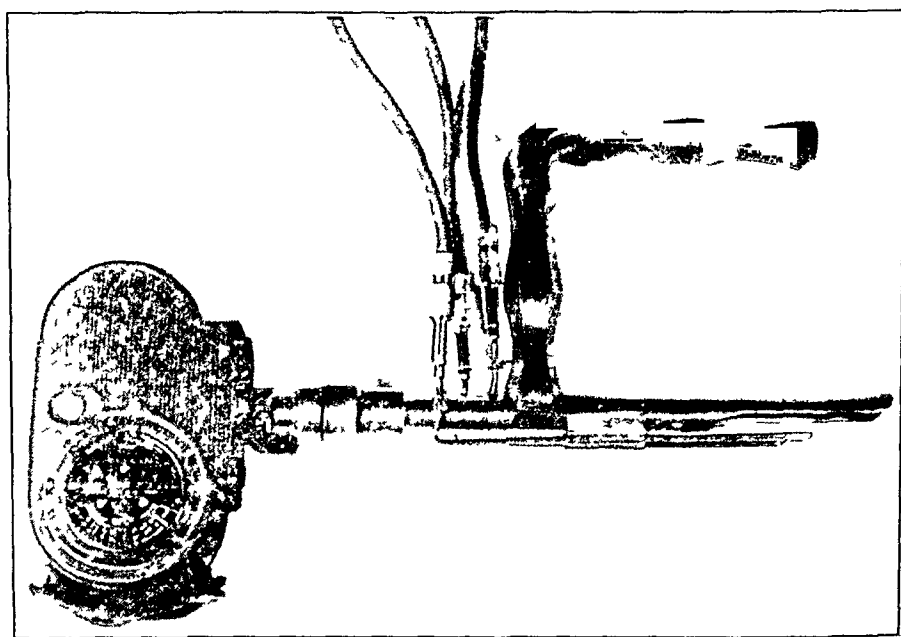
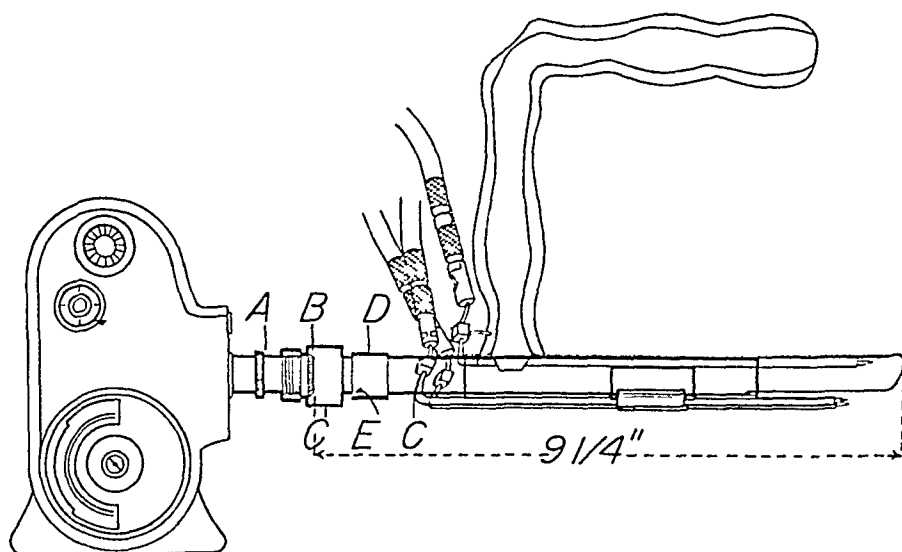


Fig 1—Above, schematic drawing of the apparatus for laryngeal cinematography. Below, photograph of the complete assembly ready for use.

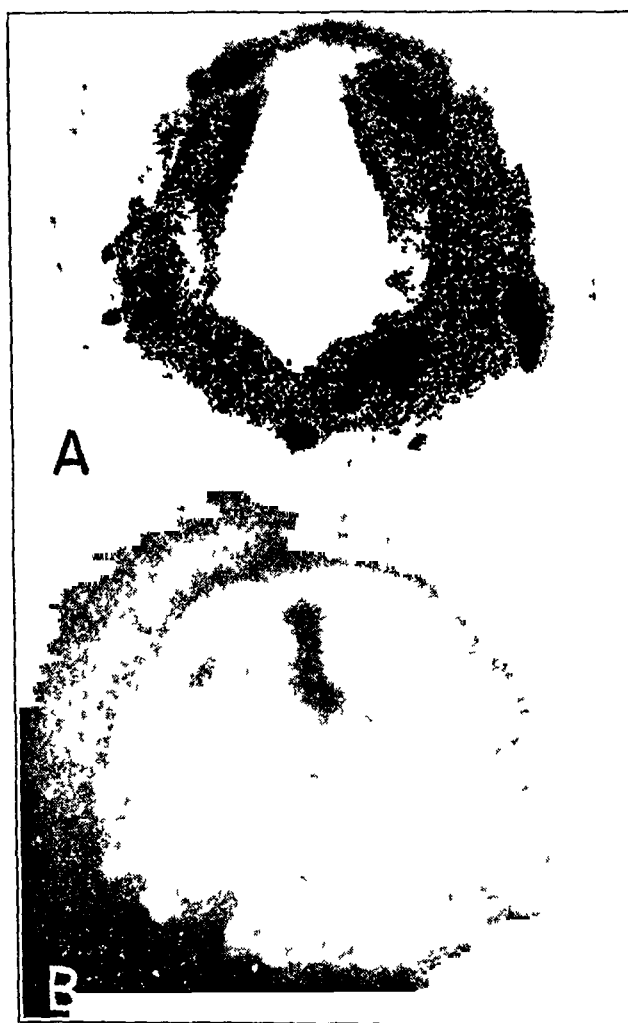


Fig 2—Enlarged photographs of the larynx (unretouched) obtained with the apparatus shown in figure 1 *A*, normal larynx, *B*, postdiphtheritic atrophy of the vocal cords

A MICROAPPLICATOR FOR USE IN OTOLOGIC WORK

G R LACY, M D, AND F A LANSON, M D, PITTSBURGH

Bacteriologic examination of material from the middle ears following paracentesis of the ear drum has always been more or less unsatisfactory. The difficulty has been due to contaminations encountered along the wall of the external auditory canal. This has been particularly true in dealing with infants and small children, in whom the canal is small. The ordinary wooden applicator tipped with a piece of cotton is so large that it is practically impossible to pass it through the canal without contaminating it with organisms which have nothing to do with the pathologic condition within the middle ear. These organisms are usually in considerable numbers and grow so freely on culture mediums that they have a tendency to overgrow or to inhibit entirely the growth of the pathogenic organisms in the exudate from the middle ear. Not infrequently the otologist is convinced that he is dealing with an infection due to a streptococcus, a pneumococcus or *Haemophilus influenzae*, and the bacteriologist can find only a diphtheroid bacillus, a staphylococcus or some other relatively nonpathogenic organism.

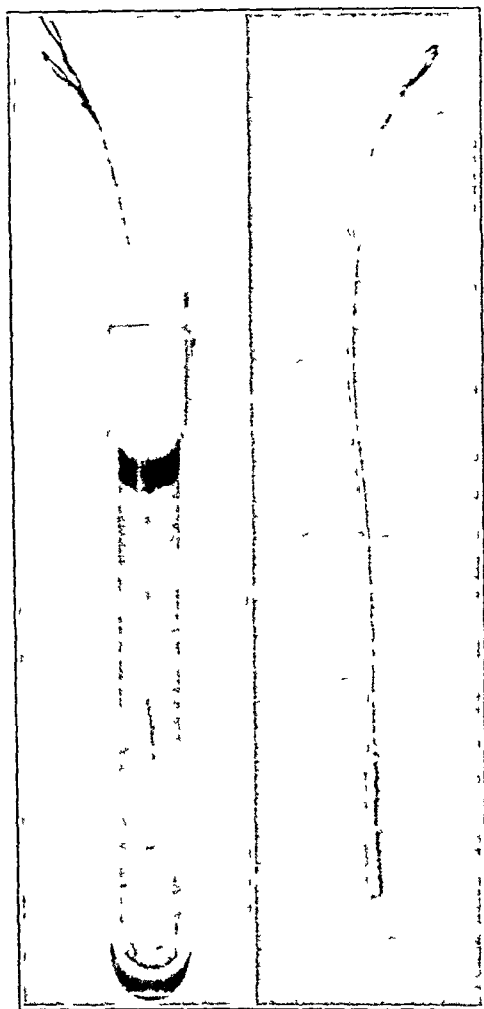
In order to overcome this difficulty, we have devised a microapplicator for collecting the exudate from the middle ear. This instrument can be passed through the smallest ear speculum for infants. Prior to myringotomy, it has been our practice to remove the ear wax, desquamated epithelium and other contaminating material. After the removal of this material, the external auditory meatus is filled with 70 per cent alcohol, which is allowed to remain for two minutes. The head is then turned so that the alcohol escapes by gravity. Two or three minutes is allowed for the alcohol to evaporate from the skin. A small sterile ear speculum is then introduced as far as possible into the auditory canal, the myringotomy is performed, and the exudate is collected on the sterile microapplicator, which is passed through the speculum in situ. By following this procedure, we have been able to isolate pneumococci, streptococci and *Haemophilus influenzae* from exudates of the middle ear without difficulty and with surprising regularity. The results of our cultures are reported elsewhere.

The instrument is made of a small piece of cotton attached to a 22 gage chromel-A¹ wire about 7 to 8 inches (18 to 20 cm) long. The cotton must be wound securely about one end of the wire so that it will not be lost in the process of

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1 The chromel-A wire which we used was made by Hoskins Manufacturing Company, of Detroit, and purchased from the Fisher Scientific Company, of Pittsburgh. It has been used by us as a substitute for platinum wire in bacteriologic work.

collecting the material for culture. It can be attached to the wire either by slightly dampening it and winding it tightly about the wire or by making small barbs on the wire near the end with a knife and winding it about the wire at this point. The opposite end of the wire should be turned back to form a loop, which acts as a handle. The accompanying photograph illustrates this. The applicator thus prepared can be placed in a clean test tube 6 inches (15 cm) long and sterilized in the usual manner. The wire is rust proof and can be used almost indefinitely. In case of necessity, the wire can be sterilized in flame, a piece of sterile cotton then wound about it with sterile-gloved fingers and



Photographs of the microapplicator

the swab used without further delay. When the material has been collected on the swab, the latter should be placed in the culture medium and permitted to remain there during the incubation. The fluid medium can then be plated as the occasion demands.

The recent success in chemotherapy of streptococcic and pneumococcic infections emphasizes the importance of accurate bacteriologic examinations of exudates from the middle ear. The use of this microapplicator has been of inestimable value to us in securing satisfactory material for these examinations. There is probably a use for this instrument in any type of surgical procedure in which a small applicator is needed.

Progress in Otolaryngology

Summaries of the Bibliographic Material Available in the Field of Otolaryngology

THE PARANASAL SINUSES

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The literature for 1938 has been unusually voluminous and to a large degree repetitious. Yet, even though the nuggets of genuine brilliance are few and far between, it is worth while noting how trends in diagnosis and treatment develop on the basis of the discoveries and writings of a few recognized leaders and soon become the accepted pattern. The more widespread the discussion of problems concerning the sinuses, the more hope for their early solution. While uniformity is more or less a utopian ideal, the nearer it is approached the better for both physician and patient.

ANATOMY AND EMBRYOLOGY

On the basis of studies made on the heads of 25 cadavers by filling the sinuses with Wood's metal, Mikhaloyts¹ made a number of measurements, both linear and of capacity, drawing certain conclusions as to the correlation of the various sinuses with each other, and the correlation of sinusal and facial measurements. The chief emphasis is laid on the absence of relation between the shape of the face and the capacity of the sinuses, as well as between the capacity of the maxillary sinuses and the linear dimensions (breadth and height) of the facial skeleton. The sum total of capacities of the left sinuses is greater than that of the right, and the average size of the individual sinuses is greater. The only exception seems to be the right frontal sinus, which is larger on the average than the left.

A similar study by Mundnich,² based on 100 macerated skulls, discloses several factors not entirely in agreement with those brought out in the preceding investigation. The author found that antrums are larger in brachycephalic heads than in dolichocephalic and that other

1 Mikhaloyts, N I. Correlative Variability of Volumes of Paranasal Sinuses, Zhur ush, nos 1 gorl bolezh 15 45, 1938

2 Mundnich, K. Zum Pneumatisationsproblem der Nasennebenhohlen, Ztschr f Hals-, Nasen- u Ohrenh 43 5, 1937

factors influencing the size of these cavities are (a) prominence of the zygoma, (b) position of the lateral boundaries of the alveolar process and (c) width of the nasal cavity proper. Excessive size of the antrum takes place in the vertical and sagittal planes mainly. The alveolar process is pneumatized in 40 per cent of the normal specimens but in only 25 per cent of those with a deep canine fossa. In the latter type the floor of the sinus may be higher than the nasal floor, which will make puncture difficult because of the thickness of the bone. The author found parallel development of the antrums and mastoids, confirming Schwartz's theory regarding constitutional factors inherent in the mucosa.

Jones³ studied the skull of a young gorilla in which the bony sutures were still visible and found that there was no true maxillary sinus. Two cavities were present in the superior maxilla, one of these, which has been called the "bulla ossea nasolacrimalis," opens into the inferior meatus and is an expansion of the lower end of the lacrimal duct. This bulla bulges backward into a larger cavity which partially surrounds it and which opens into the middle meatus but which is shown to originate far back in the ethmoid region. This cavity is called an ethmoidal "antrum." The author cites several investigators corroborating his findings.

Abbate⁴ reports an anomaly of the maxillary sinus in a boy of 17, in whom operation revealed a sagittal partition of bone about 2 mm in thickness placed diagonally so that the antrum was divided into two cavities—a larger superolateral and a smaller inferomedial. The large portion extended into the zygomatic recess and contained quantities of granulations and pus. A narrow opening in the party wall afforded inadequate communication between the two spaces.

Rosenberger⁵ examined 134 adult skulls, using only the right half on account of retaining the septum so as not to prejudice or facilitate passage of a cannula. He found it possible to catheterize 46 per cent of the skulls of white persons and 48 per cent of those of Negroes. This is a lower percentage than reported by Van Alyea. Seventy per cent of the ostiums were located in the lower third of the hiatus. Among 70 of his private patients Rosenberger was able to catheterize 68 per cent successfully. He favors the Turnbull catheter, because the tip is more flexible.

3 Jones F W. The So-Called Maxillary Antrum of the Gorilla, *J Anat* 73:116 (Oct) 1938.

4 Abbate L. Considerazioni su di un'anomalia del seno mascellare, *Arch ital di otol* 49:431 (Sept) 1937.

5 Rosenberger, H C. The Clinical Availability of the Ostium Maxillare. A Clinical and Cadaver Study, *Ann Otol, Rhin & Laryng* 47:176 (March) 1938.

Baith⁶ refers to a statement frequently encountered in the literature, that atrophic rhinitis is associated with arrested development of the sinuses. He attempts to refute this assertion by roentgen study of 82 patients having genuine atrophic rhinitis. These studies when compared with those of a control group of 300 normal persons revealed that the percentage of poorly pneumatized frontal bones was no greater in the former than in the latter. He calls attention to the fact that 17 of his patients were known to have had the disease early in life and yet their frontal sinuses were not affected. In 8 other patients the frontal sinuses were well developed, whereas the other sinuses were not. Roentgen studies in families in which atrophic rhinitis was common did not show a connection between the development of the frontal sinuses and the incidence of atrophic rhinitis. In a previous article by the same author⁷ an attempt is made to discover whether small infection in childhood has any influence on the subsequent development of the frontal sinuses. In general, the author reports, the sinuses developed despite the infection. In one group in which the frontal sinuses failed to develop, a study of the family tree proved that certain hereditary factors were the true cause and that the infection had nothing to do with the retarded pneumatization.

On the basis of roentgen studies of 370 heads, Guidotti⁸ establishes the principal variants of the fissura orbitalis superior and divides them into certain characteristic types, namely (1) triangular, (2) Phrygian cap shaped, (3) clove shaped, (4) clove shaped with spiny processes, (5) oval and (6) rectangular or quadrilateral. Orientation of the fissure with the cranial bones is bound up morphologically with characteristics of the skull. The polymorphism of the fissure needs much study in order to interpret roentgenograms adequately and distinguish abnormal from normal.

Sato⁹ made a number of macroscopic and microscopic studies of sinuses in dogs, cats, birds and amphibians. The detailed findings in each group are too numerous for abstracting. It is interesting to note that he found that the lining membrane of the sinuses in all the animals was stratified epithelium covered with ciliated epithelium, except in the

6 Barth, H. Die Pneumatisation der Starnhöhlen bei der Rhinitis atrophicans simplex bzw. Ozaena, *Ztschr. f. Hals-, Nasen- u. Ohrenh.* **44** 135, 1938.

7 Barth, H. Ueber den Einfluss der Nebenhöhlenentzündungen im Kindesalter auf die Pneumatisation der Starnhöhlen, *Ztschr. f. Hals-, Nasen- u. Ohrenh.* **43** 149, 1937.

8 Guidotti, C. L'aspetto radiografico della "fissura orbitalis superior," *Radiol. med.* **24** 1074 (Dec.) 1937.

9 Sato, J. Vergleichende Studien über die Morphologie und den Bau der Schleimhaut der Nasennebenhöhlen bei verschiedenen Tieren (Säugetieren, Vögeln und Amphibien), *Mitt. a. d. med. Akad. zu Kioto* **22** 277, 1938.

dove in which the membrane consists of a single layer of cuboidal epithelium covered with a ciliated layer. Goblet cells were found in all the animals except birds. In the tunica propria of the maxillary sinus of all mammals were many glands while in the mucosa of the other sinuses no glands were found. The author discusses theories of function and concludes that the sinuses serve to furnish heat and moisture to the inspired air especially in deep breathing and he believes that his studies support this theory which was originally proposed by Eckert-Mobius.

In a rather lengthy article, accompanied by some interesting roentgenograms Porta¹⁰ presents the result of his studies of the venous channels of the cranial diploe. Much of the work was based on an examination of the collection at the Anatomic Institute of Siena (Professor Lambertini). Numerous variations in the distribution and anastomoses between the three principle diploetic venous systems frontal parietal and occipital are discussed. The size and distribution of the veins bears no relation to the degree of pneumatization of the sinuses. Variability is individual the entire system being much more extensive in some than in others. The author believes that careful analysis of roentgenograms in cases of acute and of chronic sinusitis may enable one to locate the prominent diploetic veins draining the affected area.

PHYSIOLOGY

Larroude¹¹ found two zones of ciliary activity in the nose one comprising the anterior third of the lateral nasal wall which he calls the zone of slow expulsion, the cilia sweeping forward toward the nares and requiring twenty minutes for complete expulsion of material and the other a zone of rapid expulsion where the cilia sweep backward foreign particles being moved at the rate of 5 mm per second. Two cases of total laryngectomy were studied to determine the effects of suspended nasal breathing on ciliary activity. He found that the slow zone was not materially affected but that in the rapid zone the rate of expulsion began to slow up after six months so that at the end of a year it required twenty minutes for foreign particles to be expelled and at the end of two years the time required was an hour or more. The author expects to make a further report on the ciliary activity of the maxillary sinus in these patients since he believes that the normal changes in pressure within the sinus during respiration must have some influence on the rapidity of ciliary movements.

10 Porta C F Considerazioni sul comportamento del circolo venoso diploico, nelle affezioni infiammatorie della base cranica Arch ital di otol 50:57 (Feb) 1938

11 Larroude C A mucosa das fossas nasais e dos seios peri-nasais (nova previa) Lisboa méd 15 151 (March) 1938

Following their earlier study on the lymphatic pathways from the nasal mucosa to the lungs, Larsell, Veazie and Fenton¹² undertook a new series of experiments, which tend to support their previous conclusions. Cultures of streptococci were inoculated into the frontal sinuses of cats and rabbits. (In some animals the material was injected directly into the paralaingyal lymph nodes.) The animals were killed after from one to one hundred and four hours, and the nodes, the lungs and parts of the liver and spleen were removed under aseptic conditions for bacteriologic study. The tracheobronchial route of entry could not be entirely eliminated, as in their experiments with trypan blue, because "the insertion of a tracheal cannula to eliminate material from the upper part of the respiratory region in itself favors bacterial contamination." Aspiration, however, was guarded against by traumatic occlusion of the ostium of the sinus and by the proper posture of the head during the experiment. The bacteria were recovered in largest numbers from the paralaingyal lymph nodes. They were found also in the liver and the spleen. The conclusions are that the bacteria are carried via these nodes into the lymphatic vessels draining into the great veins, thence to the right side of the heart and then to the pulmonary capillary bed, from which point they may reach the pulmonary tissues or be carried by the blood stream to other parts of the body. "Most of the organisms that pass through the lungs are apparently filtered out of the blood stream by the spleen and by the Kupfer cells of the liver."

Scheideler¹³ made a series of experiments to determine the normal air currents within the nasal cavities. These tests were along the lines of those reported some time ago by Proetz. A model four times normal size, with a transparent septum, was employed, and cigaret smoke aspirated by a pump at the choana was photographed as it eddied through the nasal meati. The accompanying illustrations are interesting. The importance of the middle turbinate in dividing and directing the stream of air is well brought out in the experiment in which this structure is removed. Removal of the inferior turbinate leads to even greater stagnation, so that it is easy to understand why patients with atrophic rhinitis often complain of inadequate nasal breathing despite their wide open meati.

Muller¹⁴ devised a method of measuring the variations in air pressure within the antrum in relation to pressure in the nasal cavity and

12 Larsell, O., Veazie, L., and Fenton, R. A. Streptococcal Infection of the Lungs from the Paranasal Sinuses. Experimental Study, *Arch Otolaryng* **27** 143 (Feb.) 1938.

13 Scheideler, J. Die Luftströmungen in der menschlichen Nase bei Atmung, *Ztschr f Hals-, Nasen- u Ohrenh* **44** 228, 1938.

14 Muller, E. Physiologisches zur Frage der Druckschwankungen in den Nebenhöhlen, *Arch f Ohrenh-, Nasen- u Kehlkopf* **144** 100, 1937.

to the respiratory cycle. A Lichtwitz needle introduced into the middle meatus was connected with a water manometer. The vestibule of the nose was corked with a large rubber tube connected with a volume-velocity recorder. The respiratory cycle was measured by a pneumographic recorder hooked to a Marey capsule. The three curves were plotted simultaneously by the direct optical method with an electrically driven photokymograph. By this method changes in air pressure could be analyzed during every phase of the respiratory cycle. Many data were recorded, on the basis of which the author concludes that the expulsion of secretions from the middle meatus is largely dependent on the temper and degree of the varying pressures. This applied to the antrum as well, since he found that the pressure within this cavity is influenced by the air pressure and eddies in the middle meatus, as well as by the individual anatomic configuration.

Sangiovanni's¹⁵ experiments merely confirm Ploetz's findings on ciliary activity within the antrum. The progress of expulsion of instilled iodized poppyseed oil is recorded by frequent roentgenograms, which show the direction of the fluid at the various stages. The author finds the normal emptying time the same as previously reported by others.

In an attempt to explain reflex phenomena such as Sluder's syndrome, Larsell, Barnes and Fenton¹⁶ studied the effects of sectioning the maxillary nerve, the sympathetic trunk and the spinal cord at various levels in experimental animals, making observations on the rabbit's ear, which is transparent enough for the vessels to be seen under a strong light. They showed that the vasomotor response was abolished only by sectioning the cord at the sixth segment or by section of the cervical sympathetic trunk between the middle and inferior cervical ganglions. They believe that the reflex is established by afferent fibers (from the nose) of the seventh nerve to the solitary nucleus where synaptic connections are made in the reticulospinal tract. Impulses along this tract are passed to the sympathetic vasoconstrictors by way of the preganglionic fibers from the lower cervical and the upper thoracic part of the spinal cord.

Pero¹⁷ after discussing current ideas as to the mechanism of the production of referred cutaneous and musculocutaneous pains, considers more in detail the occipitotemporal pain found in meningeal infections, endocranial tumors and inflammations of the paranasal sinuses. He

15 Sangiovanni V. Sulla eliminazione dei liquidi di contrasto dalle cavità paranasali. *Arch ital di otol* 50:485 (Sept.) 1938.

16 Larsell O., Barnes J. F. and Fenton R. A. Relation of Irritation in the Region of the Paranasal Sinuses to Certain Vasomotor Changes. *Experimental Study*. *Arch Otolaryng* 27:266 (March) 1938.

17 Pero C. Interpretazione patogenetica del dolore occipito-nucale e della riginità nucale in alcune affezioni meningo-encefaliche e sinusali. *Riv di pat nerv* 52:100 (July-Aug.) 1938.

considers occipitounuchal pain as a sensitive repercussion, or a referred pain, i e., a *reflesso viscerio-sensitivo* in the sense described by MacKenzie¹⁸ This was corroborated by Lugaro¹⁹ in connection with referred pain from diseases of the celomatic viscera Nuchal rigidity is an expression of a visceromotor tonic reflex It is a phenomenon of liberation through suppression of the normal voluntary control which situated muscle exercises on the tonic reflexes of the neck

Alger²⁰ derides the theories of Strickland, Kistner and Shea regarding the function of the sinuses and advances his own, to the effect that the sinuses were constructed to serve as reservoirs for nasal secretions which would otherwise flow both forward and backward carrying the risk of asphyxia or aspiration pneumonia, particularly during sleep! He accounts for large amounts of mucus expelled in the morning on the basis of the sinuses emptying themselves when the nose is blown No scientific data are furnished to support these theories

PATHOLOGY AND BACTERIOLOGY

Semenov²¹ presents an excellent study of the surgical pathology of sinusitis, based on more than a thousand sections examined over a ten year period He shows that thickening of the mucosa in excess of 2 mm was associated with deep-seated degenerative changes in 50 per cent of the cases Purulent sinusitis was found in 72 per cent of the series and nonpurulent hyperplastic polypoid or cystic changes in 28 per cent It is interesting to note that manifest allergy was found in only 17 per cent, whereas equivocal allergy was noted in 35 per cent Mixed infection occurred in 80 per cent of the cases, the streptococcus predominated, being found in 94.5 per cent, while staphylococci occurred in 70 per cent As to postoperative repair following removal of antral mucosa, the author still believes that the newly constructed membrane is a poor substitute for the normal lining but is nevertheless infinitely better than a diseased membrane

Glatt²² comes to the same conclusion after examining specimens taken from the newly formed antral mucosa after radical operation at intervals of five weeks to eighteen months He found that the cavity is

18 MacKenzie, J Some Points Bearing on the Association of Sensory Disorders and Visceral Disease, *Brain* **16** 321, 1893

19 Lugaro, E Fisiopatologia del dolore, *Riv di pat nerv* **36** 105 (July-Aug) 1930

20 Alger, L J A New Theory of Physiology of the Sinuses, *Journal-Lancet* **58** 511 (Dec) 1938

21 Semenov, H The Surgical Pathology of Nasal Sinusitis, *J A M A* **111** 2189 (Dec 10) 1938

22 Glatt, M A Postoperative Repair of the Paranasal Sinuses Experimental Studies and Their Practical Application, *Arch Otolaryng* **27** 323 (March) 1938

not always lined with normal stratified columnar ciliated mucosa, there being areas which are merely thin smooth tissue covered with cuboidal epithelium. Remnants of mucosa left in the hope that they will act as islands for regeneration frequently degenerate into scar tissue or become cystic.

MacMahon's²³ recent investigations were for the purpose of ascertaining whether or not sulfanilamide was deposited in the tissues of the noses and sinuses of rabbits in sufficiently large amounts theoretically to affect a streptococcic infection and of studying its effect on some tissues in which infection was not present and on some in which infection had been induced by the instillation of a virulent culture of the hemolytic streptococcus into the paranasal sinuses. The drug was given by mouth to two groups of animals, one apparently normal and the other with artificially infected sinuses. Sulfanilamide was recovered in goodly amounts from the sinuses of both control and infected animals. Since the reaction was not cytologic, the author assumes that the beneficial action of the drug "must be the result of its influence on the organism itself or on its toxins in permitting more active phagocytosis by the leukocytes and monocytes." He states further, "Sulfanilamide should be as effective in the treatment of streptococcic sinusitis as in the treatment of streptococcic infection elsewhere in the body."

Greifenstein²⁴ disputes the theory that caseous sinusitis is the result of solidification of secretions following occlusion of the ostium. He believes that the accumulation of foul cheesy masses of epithelial debris, pale leukocytes and fat is due to a special local irritation causing an unusual leukocytic infiltration of the subepithelial tissues, which means an abscessed mucosa, this causes irregular fungoid projections, with areas of localized necrosis, and the subsequent exfoliation produces the foul masses. The granulating mucosa, robbed of its epithelial layers, becomes a connective tissue membrane from which all the leukocytic masses have been cast off. The inflammatory process is now at an end, and the resultant masses shrink slowly away from the membrane and more or less completely fill the lumen. These facts were all determined in experimental guinea pigs into whose antrums turpentine had been injected. In no instance did the normal ostium become occluded.

Mittermaier²⁵ discusses the various theories of edema in relation to p_H alkalosis and acidosis and comes to the conclusions generally held

23 MacMahon B. J. Influence of Sulfanilamide on Infected Sinuses of Rabbits. Chemical and Microscopic Studies, Arch Otolaryng **28** 222 (Aug) 1938.

24 Greifenstein. Spontane und experimentelle käsige Nebenhöhlenentzündungen beim Kaninchen, Ztschr f Hals-, Nasen- u Ohrenh **44** 251, 1938.

25 Mittermaier. Ueber Polypoidosis nasi und Odembereitschaft, Ztschr f Hals-, Nasen- u Ohrenh **44**.239, 1938.

in this country. He too recommends a salt-free diet, elimination of alkalis, increase of acids and proper attention to diet.

Brunner and Grabscheid²⁶ studied a series of 24 cases of Paget's disease, in 7 of which (29 per cent) there were roentgen evidences of involvement of the sinuses, particularly the sphenoid, frontal and ethmoid. Thorough study of postmortem serial sections in 1 case showed how the bony changes caused a narrowing of the lumen of the sinus through thickening of the bony walls, in some places to the point of obliteration. The author observes that the narrowing proceeds irregularly in various parts of the sinus, so that the lumen may be subdivided or displaced. It is naturally more active in the thick bones, since it proceeds from the blood vessels and the enveloping periosteum. He shows, however, that even the thin bones, such as the ethmoid septums, may be affected by a process beginning in the deepest layers of the mucosa in the same manner as it proceeds from the periosteum.

Walsh and Cannon,²⁷ on the basis of animal experimentation, clinical observation and postmortem examination, conclude that the "most suitable vehicle for intranasal medication is isotonic salt solution inasmuch as it causes no demonstrable interference with ciliary activity, whereas both hypotonic and hypertonic solutions cause definite harm to the cilia." Oils are unsuitable because they block the normal flow of mucus and because the drugs dissolved in them do not penetrate the mucous blanket to reach the epithelium. The authors found a weak solution of ephedrine the most effective vasoconstrictor, because it causes no damage to the cilia. Mild protein silver has been proved experimentally to have no bactericidal effect. The authors report 3 cases of lipoid pneumonia resulting from the intranasal use of oils. They claim that their experiments on animals have demonstrated edema, alveolitis, focal lipoid pneumonia, granulomatous lesions, necrosis and bronchopneumonia occurring as a result of the aspiration of oily solution instilled intranasally.

Mood²⁸ reports a tumor near the inner canthus of the right eye in a child of 2, which had been present since birth and was tentatively diagnosed as a mucocele. Roentgenograms showed a defect in the floor

26 Brunner, H. Die Nebenhöhlen der Nase bei Otitis deformans (Paget) des Schädels, *Acta oto-laryng* **26** 174, 1938. Brunner, H., and Grabscheid, E. Zur Kenntnis der Otitis deformans (Paget) der Schädelbasis. II. Die vordere Schädelgrube mit besonderer Berücksichtigung der Nebenhöhlen der Nase, *Virchows Arch f. path. Anat.* **301** 237, 1938.

27 Walsh, T. E., and Cannon, P. R. The Problem of Intranasal Medication, *Ann. Otol., Rhin. & Laryng.* **47** 579 (Sept.) 1938.

28 Mood, G. F. Congenital Anterior Herniations of the Brain, *Ann. Otol., Rhin. & Laryng.* **47** 391 (June) 1938.

of the frontal bone and the right nasal bone. At operation the tumor shelled out easily on the anterior and lateral aspects but more deeply it was found to be continuous with the dura. When it was severed a free flow of cerebrospinal fluid persisted for eighteen days. Healing followed with a deep scar. Histologic sections showed mucous fibrous tissue enclosing areas of glial tissue. Eighteen cases previously recorded in the literature were cited. The author believes that these tumors are true herniations because of their appearance at the fontanelles or suture lines of ununited cranial bones.

On the assumption that the ideal operation on the frontal sinus is one in which the cavity is obliterated by formation of new bone, Rossi²⁹ attempts to investigate the factors which may facilitate or retard such a process. Two series of animals were used. In one group the frontal sinuses were infected with gauze soaked with pus obtained from draining mastoids, and the other group were healthy controls. The sinuses were operated on and the entire mucosa removed by curettage. Subsequently the animals were killed and the skulls sectioned both horizontally and sagittally. The results showed that there was a greater tendency to formation of new bone in the healthy than in the diseased sinuses as evidenced by formation of adventitious bony partitions and obliteration of recesses. In both groups the external periosteum showed a tendency to proliferation and the formation of a thick fibrous or fibro-osseous tissue. The author points out that there is less osteogenic activity in the suppurative than in the healthy sinuses and concludes that the hope of achieving obliteration of the sinus by curettement of the mucosa is false and that the procedure cannot obviate the danger of a relapse.

Karies and Koch³⁰ infected the frontal sinuses of cats with bacteria cultured from the animals' own throats and obtained reactions only when the duct was blocked by edema induced by the local application of lactic acid. Acute inflammation of the influenza type resulted. The bacterial strains isolated differed from those reported by Rivers and Bayne-Jones³¹ in a similar series of experiments which they termed paraminfluenza bacilli. The authors believe that the bacteria they found

29 Rossi G. Le modificazioni del seno frontale dopo raschiamento della mucosa (Ricerche sperimentali—considerazioni cliniche). *Oto-rino-laring ital* 8:260 (June) 1938.

30 Karies A. and Koch J. Die Erzeugung von Nebenhöhlenentzündungen bei Katzen mit spezieiseigenen Bakterien aus der Gruppe der influenzabakterienähnlichen Pasteurellen. *Arch f Hyg* 120:180 (June) 1938.

31 Rivers T. M. Influenza-like Bacilli. Growth of Influenza-like Bacilli on Media Containing Only an Auto-Clave-Labile Substance as an Accessory Food Factor. *Bull Johns Hopkins Hosp* 33:429 (Dec) 1922. Rivers T. M., and Bayne-Jones S. Influenza-like Bacilli Isolated from Cats. *J Exper Med* 37:131 (Feb) 1923.

resembled those reported by Rimpau³² and Kiemsreiter,³³ which from cultural and serologic studies appear to be members of the group of pasteurellae. It seemed of importance to the authors that experimental production of infections with Pfeiffer bacillus similar to those occurring in human beings was possible in cats by the use of influenza-like bacteria recovered from the animals' own membranes.

Szende and Muranyi³⁴ made a study of the bacterial flora in 50 consecutive cases of maxillary sinusitis in an attempt to correlate these findings with observations of the clinical course. In 26 cases of acute sinusitis pneumococci and *Diplococcus catarrhalis* were found. The pneumococcic exudate was light yellow or green mucopus in clumps. The *D. catarrhalis* exudate was milky and cloudy. All the patients recovered after lavage except 4 with pneumococcic sinusitis, who recovered only after the instillation of antipneumococcus serum. Of 21 patients with chronic sinusitis 62 per cent showed streptococci, 33 per cent mixed bacteria and 1 patient the staphylococcus. The exudate in each case was grayish, turbid or milky. Twelve patients required surgical intervention.

DIAGNOSIS

Tomography, or the procedure of taking roentgenograms in a certain plane at a predetermined level, is attracting widespread interest, and more will be heard on this subject as the technic is acquired and the apparatus simplified. Di Rienzo and Boher³⁵ and Viana-Giuria and Apolo³⁶ contribute clinical studies which prove the superior value of this method over standard procedures. The former made studies of the sphenoid sinus in the frontal plane, and the pictures they submit demonstrate the configuration and outlines of the two sinuses, together with the position of the party wall, much more clearly than is possible by any other technic. Viana-Giuria and Apolo demonstrate the value of the procedure when carried out at different levels in the diagnosis of cysts of the maxilla, several illustrations of which are shown in the article. The point of origin and attachment of the growths is readily seen.

32 Rimpau, W. Ueber Infektionen des Menschen durch Haus- und Stalltiere, München med Wchnschr **84** 413 (March 12) 1937.

33 Kremsreiter, J. Menschenpathogene hamoglobino-phile Bakterien in den Luftwegen einer gesunden Katze, Arch f Hyg **118** 97 (May) 1937.

34 Szende, B., and Muranyi, L. Bacteriology of Maxillary Sinusitis, Orvosi hetil **82** 246 (March 12) 1938.

35 di Rienzo, S., and Boher, A. Tomografía del seno esfenoidal normal, Dia med **10** 134 (Feb 21) 1938.

36 Viana-Giuria, G., and Apolo, E. El valor de la tomografía en el estudio de algunos procesos patológicos del seno maxilar, Arch urug de med, cir y especialid **12** 255 (March) 1938.

Rejto³⁷ made a study of 120 cases of nasal disease in which roentgenograms had been made with the idea of correlating these findings with the pathologic changes shown by the clinical course or by operation. In 40.8 per cent of the group, by far the largest percentage, unilateral involvement of the antrum and ethmoid sinuses appeared. In the diagnosis of acute conditions the author found that transillumination was of more value than roentgenograms, the results in 18 out of 23 cases being positive and confirmed by other findings. Of 113 patients with a chronic condition 81 were operated on, either by some radical procedure or by the intranasal approach to the ethmoid sinus, so that the sinuses were inspected and the degree of pathologic change ascertained. In 61 of these the condition was proved to be empyema, 4 had thickened mucosa, some with polyps. In only 2 cases was the roentgen diagnosis in error, in these the condition was given as involvement of the soft tissues but proved at operation to be a dental cyst overlying the antrum. The author calls attention to various points in the diagnosis of cysts, tumors and malignant conditions.

Stehr³⁸ prefers the upright position in taking roentgenograms of the sinuses because of better visualization of fluid levels. Errors in interpretation may arise from differences in the thickness of bone on the two sides, the presence of septums and differences in the angle of projection of the two zygomatic processes. Roentgenograms taken after fracture of the skull or injury to the face may show darkness or cloudiness of the antrum, due to filling with blood, which is dense enough to obscure the lines of the fracture. Special projections or repeated pictures may be necessary, especially in cases of fracture of the zygoma. The author points out that dental roentgenograms often show a tooth projecting into the antrum. In such a case the diagnosis must be confirmed by a sagittal film, because it is often a false interpretation due to the diagonal line of projection. If in doubt after a tooth has been pulled, he advises one should inject contrast medium to show the presence or absence of a fistula.

Barsony and Weiss³⁹ believe that errors in interpreting roentgenograms of the antrums and ethmoid sinuses are due to inaccurate centering. They stress the importance of having the dens epistrophei exactly in the midline in all posteroanterior projections.

37 Rejto, G. Clinical Value of Roentgen Examination of the Sinuses Based on Surgical Findings, *Gyogyaszat* **77** 734 (Dec 19) 1937.

38 Stehr, L. Die Feststellung von Nasenhöhlenerkrankheiten durch die Röntgenuntersuchung, *München med. Wchnschr.* **85** 1189 (Aug 5) 1938.

39 Barsony, T., and Weiss, M. Beitrag zur Analyse der projektionsbedingten Verdunkelungen der Nasennebenhöhlen, *Röntgenpraxis* **10** 5 (Jan) 1938.

Portmann and Bonnafous⁴⁰ cite 2 cases in which identical symptoms, apparently originating in the frontal sinus were present, the sinus being enormously pneumatized in 1 case and entirely absent in the other. The roentgenograms were certainly of great value. The authors point out that in a case in which the frontal sinus is undeveloped one finds the roof of the ethmoid sinus not only lower than when the frontal sinus is pneumatized but also placed diagonally, so that it seems as if the cranial cavity projects forward between the two orbits. This has always prompted their school to approach the frontal sinus at the point of juncture of the frontal, maxillary and nasal bones, as the approach least likely to carry any danger of accidental entrance into the cranial cavity.

Olaison⁴¹ seeks some prognostic value in the study of the secretion obtained from sinuses by irrigation or aspiration. He claims that the bacterial flora are usually mixed, that staphylococci predominate and that odor is caused by *Bacillus coli*, proteus or pyocyaneus. No diagnostic criteria can be based on the first few irrigations, since the character changes rapidly except in cases in which the condition is likely to become chronic, in these cases observation of the type of secretion may indicate the necessity for operation. The fine distinctions which the author makes are not very convincing except for the well known and often stated fact that the more mucoid the secretion the better the prognosis.

Ridpath⁴² gives a good discussion of the differential diagnosis of various sinusal conditions, covering most of the accepted data in good order and as completely as the limits of the paper will permit. The significance of local and referred pain is thoroughly stressed and the differential diagnosis of frontal sinusitis from supraorbital neuralgia, tuberculosis, syphilis and tumor is clearly given. The same may be said of his discussion of pains originating in a diseased sphenoid sinus.

Among the cases cited by Northington⁴³ was 1 in which a diagnosis of a tumor of the right orbit had been made. Analysis showed the true condition to be retrobulbar neuritis due to sinusitis. The symptoms were loss of light perception, restriction of bulbar movements, absence of intraocular disease and roentgen evidence of erosion of the greater wing of the sphenoid. Pus was found in the nose. The antrum, the

40 Portmann, G, and Bonnafous. Considerations anatomiques sur le developpement des sinus frontaux, *Oto-rhino-laryng internat* **22** 136 (March) 1938.

41 Olaison, F. Prognostic Value of the Study of Pus in Sinus Infections. *Nord med tidskr* **14** 2073 (Dec 18) 1937.

42 Ridpath, R. F. Diagnosis and Differential Diagnosis of Accessory Sinus Disease, *M. Clin North America* **22** 1591 (Nov) 1938.

43 Northington, P. Some Cases of Otolaryngological Interest That Were Seen on the Neurological Service, *Laryngoscope* **48** 1 (Jan) 1938.

ethmoid and the sphenoid sinus were opened, and mucopus under pressure was evacuated. Vision returned promptly. In the second case there was swelling of the lids, headache and fever for ten days. The sinuses were suspected and were treated with packs of mild protein silver. Swelling of the lids persisted, conjunctivitis appeared, there was no disturbance of vision, no proptosis and no limitation of bulbar movements. The sinuses were clear, and no pus was recovered. A blood count revealed eosinophils up to 33 per cent. A further search disclosed trichinosis. In a third case the patient complained of persisting headache two months after a depressed frontal fracture. Observations at neurologic examination were negative except for slight changes in personality. The temperature was 102 F. It seemed that an intracranial complication might be developing. The frontal sinus was opened and some fragments of depressed bone removed. No infection was found. Two weeks later a 4 plus Wassermann reaction was recorded. The patient responded to antisyphilitic treatment.

SINUSITIS IN CHILDREN

Crooks⁴⁴ presents a good clinical evaluation of a series of 100 cases of sinusitis in children. In 24 cases the tonsils and adenoids were removed because of the presence of mucopus in the antrums. The patients were followed up, and after six months it was found that in 16 the sinus condition still persisted. The following symptoms were most commonly listed: nasal or postnasal discharge, in 84 cases, frequent colds, in 83, cough, in 82, mouth breathing, in 62, headache in 44, and otitis media, in 44. Diagnosis is made by transillumination, roentgenograms and direct puncture. A sterile needle is inserted through the trocar to avoid contamination and the contents of the sinus aspirated for culture. The predominating bacteria were pneumococci and streptococci. The author irrigates the antium, and if after six irrigations the condition is still present he does an intranasal antrotomy. Of his 100 patients, 52 were cured, 32 improved and 16 unchanged.

Bowen-Davies'⁴⁵ findings, in 55 patients of from 5 to 14 years of age, do not agree exactly with the previous author's. He found staphylococci more frequently than pneumococci or streptococci. He also aspirated under aseptic conditions, centrifuged and planted his material in blood agar for culture. The bacteriologic findings did not coincide with his roentgen findings. Of 110 antrums 66 appeared infected on roentgen examination, yet only 27 yielded a positive culture, the culture from 39 remaining sterile. His studies of the evacuation of iodized

⁴⁴ Crooks, J. Nasal Sinusitis in Childhood, *Brit. M. J.* **1** 935 (April 30) 1938.

⁴⁵ Bowen-Davies, A. The Paranasal Sinuses in Children, *Proc. Roy. Soc. Med.* **31** 1411 (Oct.) 1938.

poppypeed oil from the antiums showed that in the cases in which the culture was sterile it took an average of seventeen and nine-tenths days for complete evacuation whereas in the cases of infection the average time was fourteen and nine-tenths days (due to the reduced capacity of the sinus, according to the author) He asserts

The rapid evacuation of lipiodol does, however, prove that the function of the cilia is not affected by infection as we have been led to believe It is a well-established fact that an infected antrum may be cured by drainage, and it follows that by providing free drainage we are doing what Nature has already been doing fairly efficiently

He believes that many of his good results were due to the beneficial effect of the iodized poppyseed oil

Strachan⁴⁶ also favors proof puncture in children for diagnosis and for cultures Reporting from the Toronto Hospital for Sick Children for 1936-1937, he indicates that surgical intervention is not required as frequently as many believe Lavage of the antium was done in 184 cases, antrostomy in 8 and reduction of the middle turbinate or curettement of the ethmoid sinuses in 29

Fabinyi⁴⁷ believes that the spread of sinusitis in children is due to thinness of the dividing walls, marked vascularity of the tissues, rich communication between the blood vessels of the bone and the periosteum and the lack of fusion of suture lines Naturally stasis is favored by adenoids and swollen nasal mucosa The author favors the use of a nasopharyngoscope in the diagnosis of the source of the discharge He reports 66 cases of sinusitis occurring in infectious diseases, scarlet fever accounting for 8 per cent of the total In 21 cases the condition was complicated with orbital infection, which seems a rather high percentage In 38 per cent of the cases of orbital infection it was further complicated by bilateral mastoiditis All the patients with otitis had large tonsils and adenoids In the treatment of the orbital infections the author first tried infracting the middle turbinate or amputating the anterior end if it was obstructing If polyps were present they were removed with small forceps If this was insufficient he made an external opening Most of the scarlatinal infections appeared in the first week of the disease, and the early treatment consisted of tampons with ephedrine, inhalations of steam, suction and instillation of mild protein silver

Ebbs⁴⁸ examined the sinuses at autopsy in 496 children up to the age of 14, who died from a great variety of medical and surgical con-

46 Strachan, J G Chronic Sinusitis in Children, *Bull Acad Med*, Toronto **12** 11 (Oct) 1938

47 Fabinyi, G Inflammations of the Paranasal Sinuses of Children, with Special Reference to Acute Infectious Diseases, *Orvosí hetil* **81** 1219 (Dec 4) 1937

48 Ebbs, J H A Note on the Incidence of Sinusitis in Children, *Brit M J* **1** 385 (Feb 19) 1938

ditions, and found a purulent infection in one or more sinuses in 152, or 30.6 per cent. The incidence was higher in children under 2 years of age than in those over 2 years. The vast majority of the infections were found in the antrum. In 78.2 per cent of the cases of sinusitis there was associated otitis media, which corroborates Collom's findings of several years ago.

The entire subject is covered in a symposium before the Medical Association of Puerto Rico by Ortiz for the pediatrician, Font for the laryngologist, Landron for the radiologist and Morales for the neurologist.⁴⁹ Ortiz claims that sinusitis is much more frequent than supposed and must be considered in the etiology of such conditions as arthritis, neuritis, impaired nutrition, bronchial asthma, allergy and urticaria, pains in the head, retrobulbar neuritis, repeated attacks of otitis media, cervical adenitis and orbital conditions.

In connection with orbital abscess Fitz-Hugh⁵⁰ advises not only an external incision to liberate the pus but also removal of "part of the lamina [papyracea], enough of the ethmoids, and if necessary a portion of the floor of the frontal sinus near its inner angle to enable us to place a rubber tube diam down into the nose." This seems a bit more radical than the usually accepted practice in acute conditions. In a series of 30 cases in which orbital symptoms occurred he found 9 cases of orbital abscess and 2 of abscess of the brain and meningitis. In the 30 cases 24 patients were treated surgically, 9 by major procedures.

On the basis of history, roentgen findings and transillumination, Bettington⁵¹ advises "proof-puncture" for children, under general anesthesia, to determine the presence of pus. If the result is positive he follows immediately with a window into the antrum, using a punch forceps rather than a rasp, and the insertion of a rubber tube for drainage.

McLendon⁵² believes that roentgen rays have some value in the treatment of sinusitis in children and attributes the beneficial results to the release of antibodies from the destruction of polyps and eosinophils. He also asserts that the macrophages take on increased phagocytic activity. Of 48 cases in which this treatment was used he records cures

49 Ortiz, A. Las sinusitis en los niños. Aspectos pediátricos, Bol. Asoc. med. de Puerto Rico **30** 319 (Sept.) 1938. Font, J. H. Las sinusitis en los niños. Puntos de vista del otorrinolaringólogo, *ibid.* **30** 326 (Sept.) 1938. Landron, J. Las sinusitis en los niños. Diagnóstico radiológico, *ibid.* **30** 330 (Sept.) 1938. Morales, L. M. Las sinusitis en los niños. Complicaciones neurológicas y psiquiátricas, *ibid.* **30** 337 (Sept.) 1938.

50 Fitz-Hugh, G. S. Acute Sinusitis in Children, Virginia M. Monthly **65** 251 (May) 1938.

51 Bettington, R. H. Some Aspects of Maxillary Antrum Infection, M. J. Australia **1** 853 (May 14) 1938.

52 McLendon, P. A. Chronic Sinusitis in Children, with Special Reference to X-Ray Therapy, M. Ann. District of Columbia **7** 341 (Nov.) 1938.

in 35 per cent, improvement in 41 per cent and the condition unchanged in only 10 per cent. An analysis of 76 cases of chronic sinusitis, in which the patients ranged in age from 6 months to 12 years, revealed only 14 in which positive clinical or hereditary signs of allergy occurred and 4 in which the reaction was positive to cutaneous tests. Roentgen examination of the chest showed signs of smobionchitis in 22 cases.

Le Mee and Richier⁵³ maintain that the Proetz position fails in 20 to 25 per cent of cases in which the maxillary sinus is concerned. They propose a new position by which all the sinuses on one side can be filled, with the exception of the frontal. The patient lies on the side with a rolled sheet or small round cushion at the neck. Two maneuvers are described: (1) flexion of the head to 20 to 30 degrees and (2) rotation of 20 to 30 degrees toward the uppermost side, i. e., the side away from that whose sinuses are to be filled. In this position the lateral nasal wall is in a plane which can be completely covered by the instilled oil. They assert that the Parkinson head-low position is not favorable for displacement. Lateral flexion to 45 degrees is too far to permit bathing the middle meatus completely in the oil, which tends too much to the posterior ethmoid and sphenoid sinuses at the expense of the anterior ethmoid sinuses and the antrum. The authors performed 440 instillations by this method in a period of twenty months. In a series of 40 cases the procedure was checked by roentgenograms, which showed adequate filling in 100 per cent of the ethmoid sinuses, 92 per cent of the antrums and 27 per cent of the frontal sinuses. Incidentally 35 of the 40 patients were cured by one instillation of iodized poppyseed oil 25 per cent. In all the cases instillation was preceded by one lavage and by adequate shrinkage. The negative pressure used was 10 to 12 mm. of mercury and the average quantity of oil 5 cc.

Faier⁵⁴ finds the Proetz position satisfactory for displacement therapy and for acute cases used a 0.25 per cent solution of ephedrine in physiologic solution of sodium chloride.

Morgan⁵⁵ lists stuffy nose, pyrexia, mucopurulent discharge and loose cough as symptoms of sinusitis in children, particularly when following an attack of influenza. Chronic sinusitis is more likely to develop in a child debilitated by illness and malnutrition than is the sinus disease to cause the general debility. He believes that the term "broncho-sinusitis," coined by Wasson, expresses the true sequence. Atelectasis

53 Le Mee, J. M., and Richier, J. La "position laterale" en methode de deplacement. Nouvelle technique et resultats therapeutiques, *Bull. Soc. belge d'otol., rhin., laryng.*, 1938, p. 64.

54 Faier, S. Z. Paranasal Sinus Disease in Children, *Nebraska M. J.* **23**: 370 (Oct.) 1938.

55 Morgan, B. The Relation of Ear, Nose and Throat to the Diseases of Children, *J. Laryng. & Otol.* **52**: 855 (Dec.) 1937.

is a common precursor of bronchiectasis, and the vicious circle of sinus and bronchus is then established

Monti ⁵⁶ finds transillumination and roentgen rays unsatisfactory as diagnostic mediums for children under 5 years. He places more reliance on Proetz displacement with radiopaque fluid and diagnostic puncture.

Creasy ⁵⁷ presents his results with 60 children, aged 5 years to 14, with asthmatic syndrome associated with sinus trouble. The treatment followed was careful conservative surgical intervention, such as reduction of spurs and ridges, collapsing of cystic turbinates, intranasal antrotomy and removal of tonsils and adenoids. Twenty per cent were definitely improved for one to two years or more, and 55 per cent were symptom free for 1 to 2 months. The chief desiderata in his opinion are ventilation and drainage.

Iwamoto ⁵⁸ reports a case in which osteomyelitis of the maxilla in an infant 11 days old began with high fever, exophthalmos and swelling of the cheek. Later a fistula was found at the external angle of the orbit. There was a foul nasal discharge, and eventually the alveolar process necrosed, along with part of the anterior wall of the sinus. Removal of a large sequestrum was followed by recovery. The process lasted over a year.

A similar case, of a child of 3½ years, is recorded by Matsushita ⁵⁹. The onset was sudden, with a high temperature (40 C [104 F]), followed by swelling of the cheek and redness. Two weeks later a fistula appeared in the alveolar region anterior to the premolar. Three months later a sequestrum was removed, and recovery ensued after some delay. In Uryu's ⁶⁰ case the condition began similarly in a child of 2½ years. The infraorbital swelling was incised and drained slowly for several months. Increased swelling of the cheek and intranasal obstruction eventually led to a Caldwell-Luc operation. The sinus was found to be filled with polyps and cheesy debris, and the mucosa was degenerated, soft and polypoid. Streptococci and staphylococci were found. Recovery followed after about seventeen days.

Krakovits ⁶¹ reports 2 cases of severe infection of the antrum and the ethmoid sinus with sepsis in infants, 2 and 8 months old. One patient

56 Monti, P. C. Le malattie dei seni nasali nel bambino, *Boll. d. mal. d. orecchio, d. gola, d. naso* **56** 121 (April) 1938.

57 Creasy, R. C. The Role That Surgery of the Paranasal Sinuses Plays in the Asthmatic Child, *Laryngoscope* **48** 415 (June) 1938.

58 Iwamoto, Y. Ein Fall von Sinuitis maxillaris neonatorum mit deren Residuen, *Oto-rhino-laryng* **11** 429 (May) 1938.

59 Matsushita, H. Ein Fall von Sinuitis maxillaris neonatorum, *Oto-rhino-laryng* **10** 1111 (Dec.) 1937.

60 Uryu, E. Sinuitis maxillaris caseosa im Anschluss an akute Kieferhöhlenentzündung bei einem Kinde, *Oto-rhino-laryng* **11** 425 (May) 1938.

61 Krakovits, M. Sinus Inflammation in Infants, *Gyógyszer* **77** 730 (Dec 19) 1937.

recovered after prompt radical operation on the antrum, although the course was prolonged by complications, such as bilateral otitis media, metastatic abscesses and renal infection. The other patient died. From the description in both cases it would appear that there must have been some osteomyelitis of the maxilla, although mention of a sequestrum is lacking.

From Rumania⁶² comes a report of 2 cases of severe acute ethmoiditis with orbital complications in young children, in 1 the condition was due to grip and in the other to scarlet fever. In both cases external incision was employed, as well as intranasal drainage by simple infraction of the middle turbinate. As a rule the author advises conservative medical treatment unless there is evidence of orbital abscess or intracranial complications.

SINUSES IN RELATION TO DISEASES OF OTHER ORGANS

Babbitt⁶³ discusses otorhinolaryngologic conditions that may arise in the course of various systemic disorders, emphasizing in bold type the salient features in each case. For instance, under pneumonia he says, "keep watch of sinus and middle ear disease", under typhoid fever, "observe the sluggish nonresistant mucous surface, keep clean and guard ulcerative areas", under influenza, "treat the sinuses and the ear may clear up rapidly," and under diabetes, "suspect a rhinitis of being the systemic accompaniment in diabetes." Specialists need to read an article of this sort from time to time in order to get the picture of the patient as a whole.

Pulmonary Diseases—Kecht⁶⁴ urges careful examination of the sinuses for all pulmonary conditions that resist treatment, and when a pathologic change is found he advises radical treatment. He cites several cases that illustrate the point. Chronic bronchitis in a man of 22 that failed to yield to the usual treatment was cured when an acute exacerbation of chronic maxillary sinusitis of dental origin was discovered and eradicated. In a case of pneumonia with pleural exudate concurrent bilateral pansinusitis with a secondary orbital abscess was revealed, the condition resolved promptly after surgical treatment of the sinuses. In a third case a man of 43 had a productive cough with a foul secretion of several weeks' duration which was traced to old purulent sinusitis. Pneumothorax developed, necessitating resection.

62 Vaida-Voevod, A. Acute Complicated Ethmoiditis in Children, *Cluj med* **19** 236 (April 1) 1938.

63 Babbitt, J. A. Systemic Diseases Causing Inflammation in the Ear, Nose and Throat and the Local Management of These Conditions, *M. Clin. North America* **22** 1645 (Nov.) 1938.

64 Kecht, B. Lungenerkrankungen und Nasennebenhohlenerkrankungen, *Wien med. Wchnschr.* **87** 1219 (Nov. 20) 1937.

of a rib. Death ensued from cardiac insufficiency. Autopsy revealed empyema of the left frontal and maxillary sinuses. In the fourth case exudative pleuritis and empyema which ensued two weeks after a bilateral Lothrop operation yielded to thoracentesis. The author is of the opinion that the infection was by direct aspiration rather than lymphogenous, although he admits the possibility of infarcts occurring in remote areas of the lung via the venous channels.

Watson and Kibler,⁶⁵ analyzing a number of cases of patients with bronchiectasis sent to Arizona for the climate, found fully 90 per cent of them to be definitely allergic on the basis of a high eosinophil count in the secretions associated hay fever or eczema and consistently positive cutaneous tests. They divide bronchiectasis into three types: (1) congenital bronchiectasis, (2) mechanical bronchiectasis, as from tuberculosis, fibrous pleurisy or pulmonary fibrosis, and (3) allergic bronchiectasis. The cases, which they studied by the usual means, including roentgen studies with iodized oil, fell into four groups: (1) cases in which a diagnosis of bronchiectasis was made elsewhere because of chronic cough when roentgenograms failed to reveal bronchial dilatation but in which every evidence of allergy appeared, (2) cases like the foregoing instance, in which slight dilatation of the bronchioles was apparent, (3) cases in which more marked dilatation occurred and (4) cases of advanced bronchiectasis, with marked pocketing. They feel that if the allergic causation were recognized and the allergy treated early enough the irremediable pathologic changes of the late condition could in many instances be prevented.

A careful analysis of 75 cases of bronchiectasis by Goodale⁶⁶ reveals some interesting facts. In 65 per cent of the cases the condition had existed for five years or more, and the relation to sinusitis was therefore difficult to determine. In 32 cases the pulmonary condition was attributed to a preceding infection of the upper part of the respiratory tract, and in 20 cases the cause was definitely pneumonia. Roentgen evidence of sinusitis was found in 69 per cent of the cases of involvement of the respiratory tract and 57 per cent of those in which the lungs were affected. Another interesting observation is the possible development of sinusitis during the course of the bronchiectasis due to lowered resistance of the patient and greater susceptibility to colds. However, the author wisely points out that whether the sinusitis exists before the bronchiectasis or develops later it may be a factor in its resistance to treatment and therefore deserves adequate and thorough treatment.

65 Watson, S. H., and Kibler, C. S. Bronchiectasis. A New Conception of Its Etiology Which Makes Prevention and Recovery Possible, *J. A. M. A.* **111** 394 (July 30) 1938.

66 Goodale, R. L. An Analysis of Seventy-Five Cases of Bronchiectasis from the Viewpoint of Sinus Infection, *Ann. Otol., Rhin. & Laryng.* **47** 347 (June) 1938.

Walsh and Meyer⁶⁷ also found sinus disease in association with bronchiectasis in 66.8 per cent of 217 cases. They note that most of the patients had few subjective symptoms of the sinusitis. They believe the association of the two conditions is more than coincidental and attribute the bronchial condition to aspiration of infected material on the basis of their observation that iodized oil instilled into the nasal cavities of sleeping subjects may be demonstrated in the bronchi and alveoli by roentgenograms. In the series cited the authors found the two conditions more frequently in younger patients.

Veneziale's⁶⁸ statistics closely parallel those of the two previous authors, although the number of cases observed was smaller. He found association with sinusitis in 73 per cent of 26 cases of bilateral bronchiectasis. References to Jackson, Tucker and Clerf show that the author has followed these authors with good results.

Adams and Churchill⁶⁹ observe that situs inversus is a fairly frequent finding in bronchiectasis. The records of the Massachusetts General Hospital since 1886 show a total of 712 cases of bronchiectasis. During the same period there were 23 patients with situs inversus, 21.7 per cent of whom had bronchiectasis. This is in contrast to an incidence of 0.306 per cent of bronchiectasis in the total hospital population. The authors found associated sinusitis in 90 per cent of all of their cases of bronchiectasis, although they are not willing to admit the etiologic sequence in all instances. They state that the triad of situs inversus, bronchiectasis and sinusitis is sufficiently common to suggest a common etiologic hereditary makeup. Five typical cases are cited.

Butler⁷⁰ believes that the posterior sinuses have frequently been overlooked as a cause of nontuberculous pulmonary conditions, particularly in children. This is because the symptoms are not as well defined as those arising from disease of the anterior sinuses. In his opinion the infection more frequently takes place by aspiration of infected material than by way of the lymphatics, and he looks on postnasal discharge and a dry glistening posterior pharyngeal wall as significant symptoms.

Moatti⁷¹ cites 3 cases in which asthma of several years' duration was cured by radical operation on the maxillary sinuses. In every instance the sinus mucosa was found degenerated and polypoid. In

67 Walsh, T. W., and Meyer, O. O. Coexistence of Bronchiectasis and Sinusitis, *Arch Int Med* **61** 890 (June) 1938.

68 Veneziale, A. La broncoscopia nella diagnosi e nella cura delle bronchiectasie. Relazione fra le infezioni delle cavità accessorie del naso e le bronchiectasie, *Riforma med* **54** 302 (Feb. 26) 1938.

69 Adams, R., and Churchill, E. D. Situs Inversus, Sinusitis, Bronchiectasis. Report of Five Cases, Including Frequency Statistics, *J Thoracic Surg* **7** 206 (Dec.) 1937.

70 Butler, H. Chest Conditions Secondary to Empyema of the Posterior Para-Nasal Sinuses, *Maine M J* **29** 30 (Feb.) 1938.

71 Moatti. Asthme et sinusite, *Tunisie med* **32** 147 (April) 1938.

1 case, the condition was due to a previous dental infection, and after the sinus operation the asthma recurred. The persistence of a fistula led to a second operation, which disclosed a large area of osteitis, involving the floor of the sinus and the external table of the adjoining alveolar process. The author asserts that many such conditions are overlooked, because transillumination and roentgenograms may be misleading. He places great reliance on the use of contrast mediums in the sinuses as a means of determining the true state of the lining mucosa.

Whelan⁷² reviews the work of Tieves, Andie, Gruenwald and some of the older anatomists, as well as the more recent contributions by Mullin, Moore, Lukens, Cleif and Fenton, relative to the pathways of infection from the sinuses to the lower respiratory tract. He feels that aspiration is the more frequent pathway and testifies to the lasting benefits of a radical sinus operation in several cases in which the sinus condition was more or less dormant.

Nelson⁷³ calls attention to cases in which a condition tentatively diagnosed as pulmonary tuberculosis proved to be primarily chronic sinusitis, with secondary bronchitis and enlargement of the peribronchial and mediastinal glands. Aside from the usual findings in the nose, the author points out that tuberculosis can be excluded by a negative Mantoux reaction with injection of up to 1 mg. of old tuberculin, negative reaction of the sputum and the more rapid sedimentation in sinusitis than in tuberculosis.

Brock and Bell⁷⁴ present an interesting analysis of 306 consecutive admissions to the Waverly Hills Sanitarium during the course of a year. The sinuses are routinely examined by roentgen rays in every case on admission. Two hundred and fifty-three of the patients had uncomplicated tuberculosis and of this group 40 per cent gave evidence of some sinus involvement. There were 44 patients with bronchiectasis, nearly all of whom had sinus disease, and in some of the cases the bronchiectasis was not diagnosed until after the sinusitis had been uncovered. The authors considered it significant that whereas the bronchiectatic patients showed extensive sinus involvement the patients with tracheobronchitis gave little evidence of advanced sinusitis. They maintain that the latter group are potential victims of bronchiectasis and that it is therefore important to clear up the existing sinus condition, no matter how insignificant, as a prophylactic measure. They state further that patients with tuberculosis are more susceptible to sinus disease than normal.

72 Whelan, G. L. Relation of Nasal Sinus Infection to Involvement of the Lower Respiratory Tract, *Pennsylvania M. J.* **41** 287 (Jan.) 1938.

73 Nelson, J. E. Sinusitis with Its Complications Simulating Tuberculosis, *Dis. of Chest* **4** 57 (June) 1938.

74 Brock, B. L., and Bell, J. C. Disease of the Accessory Nasal Sinuses. Its Incidence in a Tuberculosis Sanitarium. *Am. Rev. Tuberc.* **38** 312 (Sept) 1938.

subjects but that "the *amount* of pulmonary tuberculosis *per se* has little or no influence upon the *incidence* or upon the *amount* of sinus disease in any given group"

Donaldson and Bachman⁷⁵ suggest the value of roentgenoscopic examination as a routine procedure in all cases of pneumonia for the diagnosis of coexisting suppurative antritis. They observed 2 cases in a series of 38 cases of pneumonia in which the condition was confirmed by puncture and lavage. They also believe in forcing fluids in these cases, having given up to 7,000 cc per day in 1 instance.

Arthritis—McCullom's⁷⁶ report is based on a study of 110 cases of rheumatoid arthritis observed at the Faulkner Arthritis Clinic of Columbia. In discussing the diagnosis of the condition he mentions the high sedimentation rate (up to 110 mm per hour), the agglutination of streptococci (40 to 70 per cent) and the low values for antistreptolysin. Only 26 per cent of the group having no history of previous sinusitis showed cloudy antrums, the treatment of which seemed to affect the status of the joints. In a group of 12 cases in which sinusitis was known to be present, 6 patients (50 per cent) showed definite improvement following treatment. The author finds on the evidence of this series that a definite connection between the sinus and the disease of the joints could be proved in comparatively few cases. He makes a plea to "establish the diagnosis of the type of arthritis before proceeding too rapidly with attempts to eradicate foci and claiming cures from therapy."

Nervous and Mental Diseases—Two cases of isolated paresis of the abducens nerve due to polypoid ethmoiditis are cited by Diamant.⁷⁷ In both instances the condition was relieved by operation on the sinuses. He attributes the complication to an unusual extension of the ethmoid sinuses posteriorly into the orbit.

Since Graves⁷⁸ published his report in 1932 on 1,000 cases of mental disease, with a large proportion of sinus disease, followed by Pickworth's⁷⁹ monograph on the same subject, much speculation has been rife as to whether one should not seriously consider the sinuses as common portals of entry for toxins causing mental disturbances or

75 Donaldson, B. F., and Bachman, A. Maxillary Sinusitis Associated with Pneumonia as Seen in the Winter of 1936, *Am J Roentgenol* **39** 202 (Feb) 1938.

76 McCullom, R. L. The Tonsils and Sinuses in Rheumatoid Arthritis, *Laryngoscope* **48** 314 (May) 1938.

77 Diamant, M. Les paresthesies isolees du nerf moteur oculaire externe, *Acta oto-laryng* **25** 550, 1937.

78 Graves, T. C. Sphenoidal Sinus Disease in Mental Disorder, *Proc Roy Soc Med* **27** 1515 (Sept) 1934.

79 Pickworth, F. A. Pathology of the Nasal Sinuses and Its Relation to Mental Disorder, *J Ment Sc* **78** 653 (July) 1932.

as foci for the same Smith and Ross⁸⁰ made an investigation of 818 patients with mental disorder at the Royal Edinburgh Hospital and found that only 12 per cent showed any evidence of sinus involvement. Since this is not much larger than the incidence of sinusitis in the average control group, the authors do not feel that Graves and Pickworth's findings can be corroborated. They state further that in a group of 16 patients on whom a sinus operation was indicated on the basis of definite objective findings only 1 patient showed any improvement in the mental condition following operation, the improvement being only temporary.

OSTEOMYELITIS

Levene and his associates⁸¹ studied 6,000 skulls and divided them into four groups according to the degree of bony development, extent of pneumatic cells, and expansion of the diploe. In type 1, the diploe are expanded and vascular. Both inner and outer tables are thin. The vault is thick but of light construction. Typical of this condition is acromegaly. In type 2, there is postadolescent or acquired deficiency of the anterior lobe of the pituitary gland and absence of diploetic expansion. The sinuses and mastoid are poorly developed, and the skull is dense and hard. This type is frequently associated with obesity. In type 3, there is overactivity of the anterior lobe followed later by hypofunction. The diploe are expanded and the sinuses hyperpneumatized. Secondary sclerosis begins in the inner table, extending into the diploe. There are patches of calcium deposits and the changes are most marked in the frontal bone. In type 4, there is a congenital or preadolescent deficiency of the anterior lobe, producing the type called "pituitary dwarf." The findings are similar to those in type 2: poor pneumatization, patent sutures, dentition delayed, small face and jaws. Thus the authors attempt to show that the structure of the bones of the skull is influenced by the degree of activity of the anterior lobe of the pituitary gland and that the incidence of osteomyelitis is dependent on the type of cranial bone, particularly the degree of expansion and vascularity of the diploe. Therefore one may expect to find a greater predisposition to osteomyelitis with types 1 and 3.

Sitsen⁸² records his microscopic findings in 11 cases of osteomyelitis in some of which the condition was metastatic from undetermined or previously healed foci. Expansion of the disease is by way of the veins, but destruction is due to occlusion of the afferent arteries. He

80 Smith, A. B., and Ross, C. M. Nasal Sinusitis and Mental Disorder. Survey of Eight Hundred and Eighteen Cases, *Edinburgh M. J.* **45** 343 (May) 1938.

81 Levene, G., Johnson, L. F., Lowman, R. M., and Wissing, E. G. The Role of the Hypophysis in Cranial Osteomyelitis, Petrositis and Sinus Infections, *Endocrinology* **22** 521 (May) 1938.

82 Sitsen, A. E. Ueber die Osteomyelitis der Schadelknochen, *Monatschr. f. Ohrenh.* **72** 729 (Aug.) 1938.

differentiates two types anatomically. One is the exudative or purulent type, with necrosis, and the other is the productive type, which often develops from the former and which is characterized by increased apposition and destruction of bony substance. The diploe withstands the process longer than the tables. New bone may be formed and enclose small sequestrums. The disease spreads more rapidly along the surfaces, internal as well as external, than by way of the diploe, which accounts for the appearance of extradural abscess beyond the area of palpably diseased bone.

Pastore and Williams⁸³ report a case in which osteomyelitis in a girl of 18 was due to swimming. The diagnosis was made in the fifth week, and the area was exposed by a coronal incision through the scalp, the soft tissues being reflected forward so that the entire frontal area was exposed. The bone was removed down to the supraorbital ridge. A fistula in the dura was found and cauterized. The posterior walls of both frontal sinuses were removed, the frontal and ethmoid sinuses cleaned out and drainage into the nose established by the Lothrop method. Rosenow's concentrated antistreptococcus serums 261 and 262 were diluted, mixed and poured freely into the wound. Specific antiviral was made from the organism recovered and used later in conjunction with transfusions and sulfanilamide therapy. Recovery ensued. The report is interesting because of the type of incision used and the approach to the sinuses.

Mygind⁸⁴ describes the same incision and states that the advantages in its favor are better opportunity for inspection of both the frontal and part of the parietal bone, access to the roof of the orbit and the cribriform plate, easy approach to the frontal and ethmoid sinuses from above and absence of visible scar and deformity. The incision is made just within the hair line, from a point slightly above and in front of the auricle. It goes clear through to the bone. Few large vessels are encountered. The scalp is reflected forward over the face as far down as the supraorbital ridge. When the operation is concluded the scalp is sutured back in place, drainage being provided for by tubes or flat drains at the angles of the brow. Diluted solution of sodium hypochlorite is used until drainage lessens. Nine patients were treated thus, all but 1 of whom recovered. Five of the patients had an extradural abscess, 6 had cells in the spinal fluid and 1 had an abscess of the brain.

Hennebert and Schuermans⁸⁵ also recommend the coronal incision, and they report 2 cases. In 1 case that of a man of 40, the infection

83 Pastore, P. N., and Williams, H. L. Osteomyelitis of the Frontal Bone Secondary to Suppurative Disease in the Frontal Sinus. Report of a Case, *Proc. Staff Meet., Mayo Clin.* **13** 7 (Jan. 5) 1938.

84 Mygind, S. H. Herunterklappen des Skalps bei Otitis frontis, *Acta otolaryng.* **26** 537, 1938.

85 Hennebert, P., and Schuermans, J. Deux cas d'osteite du frontal, *Bull. Soc. belge d'otol., rhin., laryng.*, 1937, p. 275.

occurred several years after an apparently successful Denker operation and intranasal ethmoidectomy, beginning in the superior maxilla and ethmoid and spreading from there to the frontal bone and the base of the skull. The patient died of meningitis. In the other case the condition followed acute pansinusitis in a woman of 24. The offending organism was a staphylococcus.

In Hill's⁸⁶ case that of a girl of 14, the infection started with acute frontoethmoiditis following swimming. Metastases appeared in the wrist, coccyx and lung at an early period and despite extensive operative procedures death ensued one hundred and thirteen days after resection of the frontal bones. Abscesses of the frontal lobe were present on both sides. In another case reported by the same author a woman of 30 in whom the condition followed an orbital abscess, recovered.

McKinney⁸⁷ submits the histories of 8 patients with 3 deaths. The general plan followed was extensive resection of bone and adequate drainage. He found roentgenograms occasionally misleading, since bone macroscopically healthy was often shown to be affected. The author believes that many patients with chronic sinusitis may show slow osteomyelitic changes.

Apffelstaedt⁸⁸ reports 7 cases with 6 cures, most of them following acute sinusitis. He attributes his good results to early radical operation with removal of both plates of the bone far into healthy areas. The exposure in most instances was by the Killian incision with extension in the median line. Although negative roentgenographic evidence is not conclusive he advises that roentgenograms should be taken frequently in conjunction with blood counts because these measures often give warning of extension.

In 3 cases reported by Hargrove⁸⁹ all the patients were children, aged 9, 10 and 11. In 2 of the cases some intranasal surgical measures preceded the onset of the osteomyelitis, 1 of the patients died of an abscess of the brain. One wonders whether intranasal surgical intervention for these acute conditions is well advised.

Ramírez Corría's⁹⁰ case was interesting because of the history of recent trauma over an area traumatized twenty-five years previously without apparent ill effects. Operation disclosed a large portion of

86 Hill F. T. Osteomyelitis of the Skull, *Maine M. J.* **29** 23 (Feb.) 1938.

87 McKinney, R. Osteomyelitis of the Frontal Bone. Report of Eight Cases. *Arch. Otolaryng.* **28** 1 (July) 1938.

88 Apffelstaedt O. Beitrag zum Krankheitsbilde der Osteomyelitis crani rhinogenen Ursprungs, *Arch. f. Ohren-, Nasen- u. Kehlkopf* **144** 315, 1938.

89 Hargrove R. M. Osteomyelitis of the Frontal Bones, Complicating Frontal Sinusitis, *Texas State J. Med.* **33** 767 (March) 1938.

90 Ramírez Corría C. Osteomyelitis frontal con secuestro y absceso cerebral encapsulado por antiguo trauma 'renovado,' *Cir. ortop. y traumatol. Habana* **5** 266 (Oct-Dec) 1937.

diseased frontal bone covering a thick fungoid area of the dura, which the author destroyed by electrocoagulation. One month later, the symptoms recurred, and a second operation disclosed an encapsulated abscess of the brain. The author believes that the granuloma which resulted from the ancient trauma was infected by way of the blood stream after the recent trauma and offers some data from animal experiments to show that infection of sterile granulomas by way of the blood stream is possible after irritation by slight trauma. The encapsulated abscess of the brain was extirpated completely, the author credits "Dr Vincent" with the idea, although the exact reference is not given.

Lewis⁹¹ reports 3 cases. In 1 the condition followed a cold in a woman of 39, who one year previously had had positive Kahn and Wassermann reactions and had received active antisyphilitic treatment. The osteomyelitis was diagnosed by the roentgenograms, and recovery followed radical surgical measures aided by transfusions and administration of sulfanilamide. The second case was that of a man of 22 who gave a history of trauma occurring seven months previously. Bilateral pansinusitis was present, and the patient recovered after two operations. In the third case, a boy of 19 who seemed to have acute ethmoiditis was operated on externally. Chronic osteomyelitis was diagnosed two months later and yielded to wide excision.

Emiliani and his associates⁹² discuss the pros and cons of radical as against conservative treatment and come to the conclusion that conservative treatment carried on as long as possible will yield the best results, radical surgical treatment being reserved for as late a date as possible. In the case they report, the osteomyelitis was discovered in the course of an operation for the evacuation of an orbital abscess and the surgical treatment, thought at the time apparently adequate, proved to be insufficient. On the thirty-fourth day the patient returned with severe frontal headache, edema and high fever. Reoperation disclosed extensive extradural abscess with pachymeningitis. Recovery ensued, with marked deformity.

Richter's⁹³ case also demonstrates the course of the favorable type, which develops at a moderate pace following an earlier external operation on the frontal and ethmoid sinuses. Recovery followed extensive resection. It demonstrates how osteomyelitis may be developing slowly after an acute infection and be undiscovered at the time of the primary operation.

91 Lewis, C. K. Osteomyelitis of the Frontal Bone Following Sinusitis, *Memphis M. J.* **13** 27 (Feb) 1938.

92 Emiliani, C. M., Farjat, F., and Gerchunoff, G. Consideraciones al margen de un caso curado de osteomielitis del hueso frontal post-sinusal a forma invasora con absceso extradural grande, *Rev. oto-neuro-oftal.* **12** 313 (Dec) 1937.

93 Richter, H. Ueber die Osteomyelitis des Stirnbens, Hals-, Nasen- u. Ohrenarzt (Teil 1) **29** 346 (Sept) 1938, *Sitzungsb. d. phys.-med. Soz. zu Erlangen* (1937) **69** 343, 1938.

Gadolin⁹⁴ discusses the various methods of approach and lines of incision advocated by various authors. He proposes a cupid's bow incision which follows the supraorbital margin just below the hair line on each side, joined by a cross incision over the root of the nose. The curved incision may be carried down along the side of the nasal root for better exposure of the floor of the frontal sinus. Placing the incisions just below the hair line avoids a scar that frequently divides the growth of hair into two separate lines. The incision is similar to those described by Seyffert and Von Eicken. If necessary one may add an incision (coronal) just above the frontal hair line. He objects to a median incision because it disturbs regeneration of bone and impairs sensation. Incisions through the brow may interfere with the action of the frontalis muscle and incisions in the temporal area may cut through fibers of the facial nerve and disturb the mimicry of the forehead. Wide disturbance of the periosteum as in laying down a large flap over the forehead predisposes to infection of the wound in the author's opinion.

Lewy⁹⁵ reports a case of gangrenous granuloma of the cheek with osteomyelitis of the facial bones in a girl of 11. It began with a swelling in the nasolabial fold following scarlet fever. An intranasal antrostomy disclosed foul pus in the antrum. An ulcer developed alongside the nose. A Caldwell-Luc operation revealed a necrotic facial wall granulations and pus. Histologic study showed only granulation tissue similar to that of syphilis. The Wassermann reaction was negative, no pathogenic fungi were found. Inoculation of guinea pigs yielded nothing conclusive. The facial wall gradually broke down, toxemia became more profound, and the patient died with pulmonary complications. An interesting observation in this case was the rapid growth of the child while in bed to a height of 6 feet (183 cm), due no doubt to irritation of the pituitary gland.

Halle⁹⁶ maintains that in a case of petrositis in which he followed the infection through the middle ear and the carotid artery into the sphenoid sinus the primary condition was sphenoiditis which extended to the petrous apex and thence to the middle ear via the tubal cells. He bases his contention on the autopsy, which disclosed the old sphenoiditis and the fistula extending from the sphenoid bone to the petrous apex.

94 Gadolin, H. R. Zur Wahl der Operationsmethode bei Osteomyelitis des Stirnbeins, *Ztschr f Hals- Nasen- u Ohrenh* **43** 283, 1938.

95 Lewy, A. A Case of Gangrenous Osteomyelitis of the Paranasal Sinuses *Arch Otolaryng* **27** 91 (Jan) 1938.

96 Halle, M. Review of a Case of Osteomyelitis of the Sphenoid Bone Extending to the Petrous Apex Through the Mastoid Process with Exenteration of the Middle Ear in 1900 *Laryngoscope* **48** 198 (March) 1938.

ORBITAL AND OCULAR COMPLICATIONS

Hirsch⁹⁷ says that if one asks a rhinologist he will say that orbital complications due to sinusal disease are rare and if one asks an ophthalmologist he will answer just the opposite. The author finds that four fifths of all orbital complications are due to acute sinusitis and in their order of frequency the routes of infection are (1) direct, through intervening bone, (2) by way of the veins and preformed channels and (3) by way of the bony lacunas. As for optic neuritis he does not think the incidence is as great as is generally believed, since he can account for only 5 to 8 per cent of the cases on a rhinologic basis.

Gheorghiu⁹⁸ feels that there is a close relation between infections of the orbit and those of the nose and attributes it to a large extent to the direct continuity of the mucous membrane of the conjunctiva with that of the nose via the lacrimal apparatus. Of 100 infections of the orbit of nasal origin, 30 per cent were due to infection of the frontal, 20 per cent to that of the ethmoid, and 20 per cent that of the maxillary sinus.

Nodine⁹⁹ classifies orbital complications into the following groups: (1) inflammatory edema of the lids, with or without edema of the orbit, (2) subperiosteal abscess with edema of the lids and orbit, (3) definite orbital abscess, (4) orbital cellulitis and (5) thrombosis of the cavernous sinus. The therapy outlined consists of (1) conservative treatment, i. e., packs, shrinkage and irrigation, (2) external incision for the evacuation of pus, (3) incision and drainage of the orbit, radical operation on the sinuses being unnecessary, (4) radical operation on the sinus, which may be indicated to decompress the orbit and permit drainage of fluid when no pus is present, and (5) prophylactic treatment.

The entire subject of orbital complications was thoroughly aired in a symposium before the Section of Laryngology of the Royal Society of Medicine¹⁰⁰. Davis reported a series of 54 cases of edema of the orbit referred to the ophthalmic surgeons, in 72 per cent of which the condition was due to frontal sinusitis (mostly in adults) or ethmoiditis (in children). The abscess in most cases was subperiosteal, especially in the beginning. He mentions 4 cases in which the condition was due to trauma with resulting hemorrhage and infection. In 1 case fracture of the roof of the orbit resulted in frontal abscess, meningitis and death. In another case the condition followed a nasal operation with perfora-

97 Hirsch, O. *Nebenhöhlen und Auge*, Wien klin Wchnschr **51** 148 (Feb 4) 1938.

98 Gheorghiu, I. *Orbital Complications of Infections of the Nasal Sinuses*, Rev san ml, București **36** 715 (Aug) 1937.

99 Nodine, E. R. *Ocular Manifestations of Sinus Disease*, J. M. A. Alabama **8** 172 (Nov) 1938.

100 *Discussion on Orbital Cellulitis Due to Sinus Infection, and Its Treatment*, J. Laryng & Otol **52** 834 (Dec) 1937.

tion of the orbital wall and subsequent cellulitis. When an orbital abscess is to be evacuated he advises suturing the lids together to protect the cornea. Thirty-seven of 39 patients were operated on by external incision plus nasal drainage. Thirty-four made a rapid recovery. One, previously operated on, already had meningitis and died. Another fatality was due to thrombosis of the superior longitudinal sinus. A third patient, an emaciated old lady, died of gangrene of the orbit. Mygind reported 86 cases observed at the Copenhagen Commune Hospital from 1923 to 1937, with a mortality of 16 per cent. External operation was performed in 46 cases, with 7 deaths. Twenty-four patients were treated conservatively, and all recovered. In some cases the nasal symptoms were minimal, which made the diagnosis difficult, and frequently roentgenograms were difficult to obtain on account of the pain and swelling. He asserts that no single symptom can differentiate a simple edema from a subperiosteal abscess. If the condition is doubtful, he believes, it is better to operate early, even if pus is not obtained, particularly if the symptoms are alarming. He advises also an incision adequate to permit inspection of the orbital wall. Capps stated, "A patient cannot be considered to have orbital cellulitis unless proptosis is present, indicating an intra-orbital phlegmon." He also advises incision when one is in doubt. Watson-Williams made a point in relation to the differentiation of subperiosteal abscess from true orbital cellulitis, that in the latter the bulb is pushed forward and chemosis is prominent. W. Stewart felt that the infective agent has much to do with therapy. If streptococci are present, with edema and high temperature, one should not operate early but should undertake medication with prontosil (form recommended not specified).

Fine¹⁰¹ describes a case resembling one of aseptic thrombosis of the cavernous sinus, which in his opinion could only be designated as a case of "primary serous orbital cellulitis," since the condition resembled "serous tenonitis" as described in the ophthalmic literature. The latter, however, is circumscribed in the region of the ocular muscles, whereas the former involves all the orbital structures. The process is one in which there is a serous effusion into the orbit causing chemosis, swelling of the lids and the conjunctiva and severe pain over the frontal and maxillary regions but no fever or constitutional symptoms. Aspiration in his case revealed sterile fluid, and the leukocyte count was normal. Opening of the sinuses revealed no pathologic change, and the author believes that the condition was allergic. The treatment should be dehydration by intravenous administration of a 50 per cent solution of dextrose with magnesium sulfate by mouth and limitation of the intake of fluid.

¹⁰¹ Fine, A. Primary Bilateral Serous Orbital Cellulitis, *Ann Otol, Rhin & Laryng* 47 370 (June) 1938

Terracol and his associates¹⁰² report a case of acute frontoethmoiditis with marked edema of the lids and conjunctiva and displacement of the bulb which receded under palliative treatment. They assert that the orbital reaction is due to vasomotor disturbance from involvement of the sympathetic nerve and is to be distinguished from orbital abscess by the pain, mydriasis, anesthesia of the cornea and impaired vision.

Wassenaar's¹⁰³ article is a brief discussion on the differential diagnosis of orbital tumors and abscesses.

Szolnoky¹⁰⁴ states that according to Verbely exophthalmos is due to one of two classes of disorder, those causing orbital stenosis and those causing orbital pleriosis. In the first class are (1) exophthalmos dysplasticus, due to developmental errors, (2) exophthalmos hyperplasticus, due to uniform thickening of the orbital walls—these two have nothing to do with sinuses—and (3) exophthalmos paraplasicus, due to displacement of one of the orbital walls. Mucocoeles of the sinuses belong to the last group. A typical case is cited. Acute processes cause exophthalmos by stagnation of secretion and swelling of the walls, with pressure on the orbital contents. As for orbital pleriosis the authors mention hematoma from trauma or operation, emphysema, inflammatory processes and carcinoma. Much of the mechanics of both types of exophthalmos is discussed in the paper.

Sydenham¹⁰⁵ presents a review of the anatomic relations of the sinuses to the optic nerves and the orbits. Abnormalities of the ethmoid and sphenoid sinuses are shown which could account for early involvement of the visual apparatus. While citing other writers reporting large numbers of such complications, the author himself is more reticent. He recalls only 2 cases of neuroretinitis in which autopsy showed definite sinus infection. He records many cases of sphenoiditis with no ocular symptoms and seems to feel that precipitate intervention in a sinus without adequate findings is not justified.

Tseshinskiy's¹⁰⁶ report of 4 cases of retrobulbar neuritis seems to corroborate Sydenham's conservatism, because the records show that operations performed on the ethmoid and sphenoid sinuses revealed

102 Terracol, Ybanez and Vergues. A propos d'un cas de sinusite fluxionnaire, *Arch Soc d sc med et biol de Montpellier* **19** 92 (March) 1938.

103 Wassenaar, T. Orbital Complications in Sinusitis, *South African M J* **12** 181 (March 12) 1938.

104 Szolnoky, Z. Beziehungen zwischen Exophthalmus und Nasennebenhohlen, *Ztschr f Hals-, Nasen- u Ohrenh* **43** 215, 1938.

105 Sydenham, F W. The Richard Middlemore Lecture, 1937 [Relationship of Orbital and Optic Nerve Infection to Accessory Sinus Disease], *Birmingham M Rev* **13** 62 (June) 1938.

106 Tseshinskiy, A I. Surgical Therapy of Rhinogenic Retrobulbar Neuritis, *Zhur ush, nos 1 gorl bolez* **15** 159, 1938.

practically no pathologic change and in each instance the vision failed to return to normal. In case 1 four months after operation he reports vision 0.6, with atrophy of the optic nerve, in case 2 after four months the comment is "slow return of vision, relative central scotoma to red and white vision stationary", in case 3 he states, "the eyesight is not getting worse," and in case 4 he reports signs of neuritis considerably decreased.

Lemoine's¹⁰⁷ case resembled retrobulbar neuritis, but the condition was due to a lesion located back of the chiasm. The patient had hypertrophy of the prostate at 33 and impotence at 37. A diagnosis of deficiency of the anterior lobe of the pituitary gland was made. He improved under glandular therapy. A lesion of the right optic tract developed and progressed to complete loss of central vision in twenty-one days. Roentgenograms showed poorly ventilated sphenoid sinuses extending into the posterior clinoid processes. At operation a hemorrhagic area was found in the posterior wall of the right sphenoid sinus in the portion extending into the clinoid process and close to the superior portion of the optic tract, involving fibers corresponding to the defect in the visual field. After operation the vision and fields returned to normal. Six weeks after therapy the sexual vigor reappeared. The author's theory on this case is that the old infection of the sphenoid sinus involved the tract by direct contiguity as well as by absorption of toxins from the focus.

Teulières¹⁰⁸ favors the Rhese and Hirtz positions for roentgen studies and is inclined to be conservative in doubtful conditions. Otherwise he limits his surgical intervention to antrostomy, resection of the septum and middle turbinate and puncture or enlargement of the ostium of the sphenoid sinus. He is opposed to curetting the mucosa of the sphenoid sinus.

Strauss and Needles¹⁰⁹ feel that despite the frequency of multiple sclerosis, the cases of spontaneous recovery and the large percentage of the population having sinusal disease and despite the frequent ill effects of surgical intervention there are still some cases in which operation is indicated. They rely on a careful examination by the otolaryngologist to determine the presence of sinusal disease and advise operation if the visual impairment is progressive, even though in some of these cases the condition may later turn out to be multiple sclerosis. They have found typhoid vaccine a valuable adjunct in the treatment.

107 Lemoine, A. N. Lesion of the Optic Tract Probably the Result of Infected Sphenoid Sinuses, *Arch. Ophth.* 20:966 (Dec.) 1938.

108 Teulières, M. Les névrites optiques d'origine sinusienne, *Progrès méd.*, Oct. 29, 1938, p. 1457.

109 Strauss, I., and Needles, W. Optic Nerve Complications of Accessory Nasal Sinus Disease, *Ann. Otol., Rhin. & Laryng.* 47:989 (Dec.) 1938.

Brault¹¹⁰ reports a cure in a case of retrobulbar neuritis in which the sphenoid sinuses were opened by the Hirsch transeptal route. No suppuration was found, nor was the mucous membrane hyperplastic. He attributes the cure to improved ventilation, since he found the natural ostia small.

Lagrange and Goulesque¹¹¹ had 2 cases of iridocyclitis in a patient with a positive Wassermann reaction. Specific therapy failed to influence the process, which yielded promptly, however, to drainage of an occult infection of the antrum and the ethmoid and sphenoid sinuses. They explain the dramatic cure on the basis of surgical interruption of an allergic cycle in which the reticuloendothelial elements had been responding to a bacterial allergy originating in the sinuses. This explanation accounts also for the resistance of the lesion to antisyphilitic treatment.

Jeschek¹¹² reports 4 cases of recurring iridocyclitis in patients ranging from 29 to 50, in whom sinus disease, such as suppurating maxillary sinusitis and ethmoid polyps, was present. Prompt recovery followed adequate surgical intervention. The author cites numerous authors but fails to mention Gill, whose articles on this subject are so complete.

In 3 of Nail's¹¹³ cases definite pathologic change was found in the antrums and the sphenoid sinus, and prompt surgical intervention was followed by recovery of vision.

Steurer¹¹⁴ reports a case of emphysema of the orbital conjunctiva following puncture of the antrum in a man of 61. The lids were not affected, nor was the bulb displaced. The author believes the condition was due either to a defect in the roof of the antrum or to a crack in the thin bone from the impact of the air. He discusses the various routes by which air may enter the orbit or palpebral apparatus and shows some sketches taken from the work of Heerfordt¹¹⁵. The chief point brought out is that the direction the air takes depends on whether it enters in front of or behind the septum orbitale.

110 Brault, J. Trepanation du sphénoïde par voie trans-septale dans un cas de névrite optique retro-bulbaire. Guérison, *Union med. du Canada* **66** 1225 (Dec.) 1937.

111 Lagrange, H., and Goulesque, J. Irido-cyclite et infection focale (allergique, système réticulo-endothélial, étiogéniques), *Ann. d'ocul.* **175** 493 (July) 1938.

112 Jeschek, J. Sinusitis als Ursache der Erkrankungen des Uvealtraktes, *Ztschr. f. Hals-, Nasen- u. Ohrenh.* **44** 264, 1938.

113 Nail, J. B. Sinuses as Foci of Infection, *Texas State J. Med.* **33** 572 (Dec.) 1937.

114 Steurer, O. Ueber Emphysem der Orbita nach Kieferhöhlenspülung, *Hals-, Nasen- u. Ohrenarzt* (Teil 1) **29** 343 (Sept.) 1938.

115 Heerfordt, C. F. Ueber das Emphysem der Orbita, *Arch. f. Ophth.* **58** 123, 1904.

Novick ¹¹⁶ records 2 cases of paralysis of the inferior oblique muscle occurring a few days after a Caldwell-Luc operation. The diplopia was crossed instead of homonymous, because of preexisting exophoria. The condition lasted one month in the first case and a few days in the second. He attributes the complication to curetting of the anterior internal angle of the sinus, which is out of range of the operator's vision and which may be the site of a dehiscence.

INTRACRANIAL COMPLICATIONS

Courville and Rosenvold ¹¹⁷ made an extensive analysis of all the cases of intracranial complications that were found in a series of 15,000 autopsies at the Los Angeles General Hospital. The evidence shows that the sinuses are responsible for only a small proportion of these complications, only 51 in the entire series. In only one eighth of 337 cases could meningitis be traced to sinus origin. Acute sinusitis accounted for the condition in a large proportion of these. The article takes in a general study of complications in the brain due to infections other than sinusitis, including a discussion of avenues of transmission and of the pathologic pictures.

Hirsch ¹¹⁸ found 266 cases of endocranial complications in sinusitis over a ten year period, in 42 per cent of which the complications came from the frontal sinus, in 17 per cent from the sphenoid and in the rest from more than one sinus. Meningitis was due to sphenoiditis more frequently than to frontal sinusitis. The prognosis of meningitis was bad. In half of the cases abscess of the brain followed a preceding orbital abscess, and frontal sinusitis was the most common cause. He advises packing the cavity of an abscess of the brain and changing the pack at frequent intervals.

Sargnon ¹¹⁹ makes a comparison between intracranial complications due to sinusitis and those due to otitis media. Osteomyelitis, for instance, is more frequent among the former and more severe because of the frequent development of meningitis. Pachymeningitis and extradural abscess, on the other hand, are less frequent, and intervention is usually delayed because they are so frequently latent. When infection from a sinus passes beyond the dura it causes localized or generalized serous meningitis less frequently than does infection of

116 Novick, J. N. Paralysis of the Inferior Oblique Muscle Following the Caldwell-Luc Operation, *Arch Otolaryng* **28**:412 (Sept.) 1938.

117 Courville, C. B., and Rosenvold, L. K. Intracranial Complications of Infections of the Nasal Cavities and Accessory Sinuses. Survey of the Lesions Observed in a Series of Fifteen Thousand Autopsies, *Arch Otolaryng* **27**:692 (June) 1938.

118 Hirsch, O. Nebenhöhlen und Gehirn, *Wien klin Wchnschr* **51**:116 (Jan 28) 1938.

119 Sargnon. Complications méningées des sinusites de la face, *Avenir méd* **35**:114 (April) 1938.

otitic origin. Suppurative meningitis is prognostically more grave when of sinal origin, and the same applies to abscess of the frontal lobe because of late recognition due to lack of focal symptoms.

On the basis of a study of several cases and a review of the literature, Karbowski¹²⁰ can find no definite syndrome or combination of symptoms characteristic of subdural abscess whereby it can be differentiated from a cerebral abscess. He agrees with Hecquet that symptoms referable both to the meninges and the brain may be present at the same time. Meningeal symptoms may arise suddenly and disappear as quickly. Their reappearance, however, indicates diffuse inflammation of the subarachnoid space. Examination confirms the former observation, in the beginning the fluid is under pressure, cloudy and full of polynuclear cells. Gradually it clears and may even become normal because of resistance of the tissues and walling off of the infection. Another symptom of subdural abscess is the periodic remission of symptoms. The author maintains that frequently the course is like that of a subdural hemorrhage with recovery. In both instances, however, the process may reach a point at which the tissues are no longer able to withstand the pressure. This is manifested by a sudden exacerbation of symptoms, and frequently death ensues rapidly. The only two characteristic symptoms are aphasia and paresis of the extremities, these occurring only in more posterior lesions. Among the points of differentiation between subdural and cerebral abscess aside from those mentioned as focal are slowness of the pulse in the latter as against frequent tachycardia in the former and more frequent changes in the fundi. In only 1 of 44 cases of subdural abscess were changes in the fundi present.

Bertolet¹²¹ reports the following case. A man of 44 fell on his nose and was rendered unconscious for a short period. No other ill effects were noted except temporal ecchymosis. He had been free from symptoms up to a year before examination, when a swelling appeared on each side of the nasion. Later headache and exophthalmos developed. Roentgenograms showed obliteration of bony detail, especially in the right frontal area, and destruction of the inner wall of the orbit. Preoperative diagnostic opinion was divided between mucocele, low grade osteomyelitis, tuberculosis and syphilis. At operation, when the incision was made, a mass extruded, and respiratory failure ensued, followed rapidly by death. Exploration revealed a cavity 7.5 cm deep, filled with thick caseous and hemorrhagic material. Cultures were sterile. The author believes it to have been a sterile abscess although others felt that it was an old hematoma or broken-down cholesteatoma. Comment is made on the absence of symptoms (until late) in the presence of such extensive involvement of the brain.

120 Karbowski, B. Weitere Beobachtungen an Subdural- bzw. Intermeningealabszessen, die als Komplikation von Nebenhöhlenerkrankungen auftreten, *Monatschr f. Ohrenh.* **72** 512 (May) 1938.

121 Bertolet, J. A. Atypical Massive Abscess of the Frontal Lobe, *Arch. Otolaryng.* **28** 621 (Oct) 1938.

Langeron and Lagarde¹²² report an abscess of the brain at a depth of 6 cm in the frontal lobe which gave rise to symptoms rather late in the course of frontal sinusitis for which an external operation had been performed with findings of 'osteitis frontalis' due to staphylococci. The symptoms which led to the second operation and discovery of the abscess were psychic derangement, jacksonian seizures on the contralateral side, exaggerated reflexes, Babinski and Kernig signs and ankle clonus. The spinal fluid was under pressure and contained albumin and a few cells. The fundus was normal. Later there were general convulsions (right side), deviation of the eyes, grinding of the teeth and incontinence. At autopsy the abscess was found to have no capsule but to be surrounded by an extensive area of encephalitis.

Frotzel¹²³ states that the literature indicates that abscess of the frontal lobe occurs less frequently by direct extension than by retrograde thrombophlebitis. He cites a case of its occurrence by the latter route in a boy of 17, in which on the fifteenth day of acute frontal sinusitis the sinus was opened because of severe headache, vomiting and high fever. A subperiosteal abscess and local osteomyelitis were found. Relief lasted only a few days. With recurrence of symptoms a second operation was done, which revealed a necrotic posterior wall, tense discolored dura and a superficial abscess of the brain. Pneumococci and fusiform bacilli were recovered. The patient died four days later of progressive encephalitis.

Lefebvre and his associates¹²⁴ report 2 cases in which the condition resembled tuberculous meningitis but was proved to be due to aural or sinusal infection. In the first case (both were cases of children), although no tubercle bacilli were found the findings of lymphocytes in the spinal fluid, absence of bacteria, moderate temperature, delirium, ocular disturbance and gradual decline, all seemed to corroborate the tentative diagnosis of tuberculosis. Autopsy, however, revealed purulent meningitis, purulent otitis media and mastoiditis and purulent frontal and maxillary sinusitis. In the second case the condition was less severe and the patient recovered. Meningitis was present, with a preponderance of lymphocytes in the fluid. Fortunately, purulent ethmoid and maxillary sinusitis was discovered and promptly treated. The authors believe the meningeal symptoms were due to a simple lymphocytic meningeal reaction to adjacent infection.

122 Langeron, L., and Lagarde, L.: Abscès du cerveau secondaire à une ostéite frontale, *J. de méd. de Paris* 58:141 (Feb. 17) 1938.

123 Frotzel, J.: Abscess of the Frontal Lobe Due to Acute Frontal Sinusitis, *Časop. lék. česk.* 77:637 (May 20) 1938.

124 Lefebvre, G.; Minet, P., and Christiaens, L.: Deux cas de méningite pseudo-tuberculeuse d'origine sinusale, *Echo méd. du Nord* 8:641 (Nov. 21) 1937.

Teed ¹²⁵ studied several series of reports of autopsies, totaling 28,400 autopsies, for the purpose of discovering how frequently an infection of the sphenoid sinus was the primary cause. He found only 7 cases in which the condition was rhinogenous as against 109 in which it was of otitic origin. He agrees with Eagleton and others that the spread to the endocranium takes place via the blood vessels. He collected 129 cases of meningitis reported in the literature as originating in the sphenoid sinus. He cites 4 cases personally observed, in all of which the patients were seen in coma and died. The prognosis is always bad because this condition is not diagnosed early. The symptoms are ill defined, but the author calls attention to glycosuria and mental disturbances as symptoms of particular significance. The importance of sphenoiditis in connection with meningitis may be gathered from the fact that while the sphenoid sinus is involved in only 15 per cent of all cases of sinusitis it is responsible for 35 per cent of all attacks of meningitis of sinusal origin.

Sargnon ¹²⁶ calls attention to the avenues by which infection of nasal or sinusal origin may reach the large veins of the cranial cavity causing thrombosis and sepsis. Among these are (1) an inconstant ethmoidal vein, connecting the nasal cavity directly with the superior longitudinal sinus, (2) an aberrant branch of the anterior ethmoid vein, by which the sinus communicates with the pituitary veins (he calls it "la veine du lobule orbitaire"), (3) dural veins perforating the dura, (4) diploetic veins, (5) superior cerebral veins and (6) anastomotic veins between the superior longitudinal sinus and the sinuses of the base, these being (a) Trolard's grand anastomotic vein, which runs along the fissure of Rolando receiving tributaries from the surface of the brain, especially in the frontal region, and (b) Labbe's anastomotic vein, located posterior to the former and connecting the lateral sinus with it or directly with the superior longitudinal sinus. Infection of the latter may be secondary to otomastoiditis by way of the venous sinuses of the base or directly from nasal sinusitis or orbitofacial infection. Although the symptoms are not characteristic he mentions the following as being at least strongly suggestive: (1) local pain, epistaxis and dilatation of the veins of the forehead (*caput medusae*), (2) septicopyemic symptoms, and (3) convulsions, hemiplegia and jacksonian attacks.

Kecht ¹²⁷ claims that rhinogenic sepsis exclusive of osteomyelitic conditions is extremely rare, since he has been able to find only 9 cases in the literature in which the diagnosis was corroborated by the report

125 Teed, R. W. Meningitis from the Sphenoid Sinus, *Arch. Otolaryng.* **28** 589 (Oct.) 1938.

126 Sargnon, A. Les thrombo-phlébites encéphaliques par naso-sinusites, *Avenir med.* **34** 300 (Dec.) 1937.

127 Kecht, B. Ueber rhinogene Sepsis, *Monatschr. f. Ohrenh.* **72** 395 (April) 1938.

of an autopsy Twenty additional cases reported as cases of rhinogenic septicopyemia without positive evidence of involvement of cranial venous sinuses are rejected because the pathogenesis is not clear and because some of them occurred during an attack of influenza or scarlet fever in which the sinusal disease was only a complication of a severe systemic condition The author found 14 cases of true sepsis in a series of 2,000 cases of acute and chronic sinusitis in which admission to his clinic was made in twenty-five years In half of these metastatic foci developed He cites 2 cases in detail In 1 the condition occurred in chronic ethmosphenoiditis with acute exacerbation Intranasal operation was followed by septic symptoms and a large metastatic abscess in the gluteal region, which was opened ten days after the sinusal operation In the second case the condition followed grip, acute frontoethmoiditis was complicated by an orbital abscess sepsis and meningeal symptoms Autopsy revealed metastatic infarcts in both lungs abscess of the cardiac muscle and other foci in the liver, spleen and kidneys

25 East Washington Street

(To Be Concluded)

News and Comment

AMERICAN LARYNGOLOGICAL ASSOCIATION

The following resolution was adopted at the final meeting of the American Laryngological Association

"WHEREAS, It has become evident that in many communities and rural districts little or no attention has been paid by school authorities to disabilities affecting children, especially those resulting from disorders of vision, hearing and speech, be it

"RESOLVED, That the American Laryngological Association approves and recommends the provision of funds by foundations and other appropriate agencies to carry out adequate programs for the detection of visual, hearing and speech deficiencies which constitute a handicap or a threatened handicap to school children, and for providing through the cooperation of qualified specialists and of state, county and local medical societies appropriate medical care for indigent and underprivileged children who may be afflicted or threatened with such handicaps"

Abstracts from Current Literature

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THE PREVENTION OF DEAFNESS S J CROWE and JOHN W BAYLOR, J A M A
112 585 (Feb 18) 1939

This communication deals with one phase of the authors' investigation of the recognition and prevention of the commonest type of deafness and follows a preliminary report which was published in 1937. It is based on a detailed observation of 60 children, carried on in some cases for nearly ten years. This study is founded on the principle that a long-continued partial obstruction of the eustachian tubes causes retraction of the tympanic membranes, impaired hearing for high tones with relatively good hearing for low tones and sometimes a total loss of hearing by bone conduction and that the primary cause is hyperplastic lymphoid tissue around and in the pharyngeal end of the eustachian tubes.

This tissue is more susceptible to irradiation than are the adjacent epithelium, muscle and bone, as pointed out by Heineke in 1905, and the fact suggested to the authors that its surgical removal might be supplemented by follow-up use of radium and roentgen rays. With the aid and advice of Dr C F Burnam, some ten years ago, the lymphoid elements around the eustachian tubes were treated with roentgen rays through portals near the angle of the jaw and with radium in an applicator small enough to pass along the floor of the nose, with the nasopharyngoscope in one side of the nose and the applicator in the other. Thus it was possible to place the applicator under visual control.

This technic was carried out in cases of (1) slowly progressive deafness beginning with the high notes, (2) recurrent attacks of otitis media in children with a tendency to lymphoid hyperplasia and (3) long-continued discharge from the ear after myringotomy or a simple or radical mastoidectomy.

Several case reports are cited, and audiograms and other details included. The doses for the various roentgen and radium treatments are clearly outlined. It is emphasized that doses of radiation should be small, so that no injury to the pituitary gland, nasopharyngeal mucosa or inner ear may take place.

The authors conclude that the most common type of middle ear deafness in adults begins during childhood, with such gradual progression that it is likely to be overlooked until it is too late. The middle registers (e g, speech) are not involved. They feel that if school children in the primary grades were examined with a nasopharyngoscope once a year and those with hyperplastic lymphoid tissue in and around the orifice of the eustachian tubes were treated with radiation as often as necessary to insure normal functioning of the tubes the number of deaf adults in the next generation could be reduced by 50 per cent.

GORDON, Philadelphia

INFECTION OF LABYRINTH WITHOUT SYMPTOMS IN ACUTE OTITIS MEDIA
B KECHT, Monatschr f Ohrenh 72 1137 (Dec) 1938

The author reports the case of a man of 19 who acquired otitis media on the left side. The pus revealed hemolytic streptococci. In the fourth week of the acute otitis, mastoiditis was discovered, and tests revealed loss of function of the internal ear (deafness and no response to caloric and turning tests). As the patient's hearing was normal before the otitis media set in, the labyrinthitis apparently developed during the acute process. It was surprising that this labyrinthitis developed without dizziness. After a simple operation on the mastoid, followed by labyrinthectomy, the patient was cured. The writer believes that the infection of the internal ear occurred through the promontorium.

LEDERER, Chicago

FUSOSPIRILLOSIS AND MYIASIS OF THE EXTERNAL CANAL A MONTEIRO, Monatschr f Ohrenh **72** 1162 (Dec) 1938

In a boy of 7 years the author found larvae of fleas within the external canal. By scratching, the boy infected the skin of the external auditory canal with fusiform bacilli and spirilla of Vincent. Consequently a large ulcer developed at the external auditory meatus. Intramuscular injections of bismuth were of no avail. Local administration of a paste of bismuth carbonate and olive oil was successful after removal of the larvae from the external canal.

LEDERER, Chicago

RECOVERY FROM LABYRINTHOGLNOUS MENINGITIS WITHOUT OPERATION ON THE LABYRINTH G TSIMEAS, Monatschr f Ohrenh **72** 1168 (Dec) 1938

The writer describes 4 cases of purulent labyrinthitis in which recovery followed operation on the middle ear and mastoid process without opening of the labyrinth. In 3 instances the labyrinthitis followed acute exacerbation of chronic otitis, and in 1, acute otitis media.

LEDERER, Chicago

SEDIMENTATION REACTION IN OTITIS MEDIA AND ITS COMPLICATIONS P FRENCKNER, Acta oto-laryng **26** 309, 1938

Frenckner, together with Hamberger, has followed all the cases of otitis media at the Sabbatsberg Clinic for a period of three years. His material consists of 1,341 cases of otitis or otitis with otitic complications uninvolved by the presence of any other disease which might affect the sedimentation rate to any marked degree. He also studied 147 additional cases in which otitis was complicated by such diseases as angina, bronchopneumonia, nephritis and polyarthritis. As a rule the sedimentation rate was taken every second day throughout the entire course of the disease. The studies were made partly according to Westergren's original method, called "macro" method, and partly by Strom's "micro" method from the finger tip. In many cases parallel tests with the two methods were made and the author found them fairly consistent.

He found little disturbance in the sedimentation rate in cases of chronic otitis, with or without complications.

In acute otitis the sedimentation rate rises in the first week or first two weeks in children and then gradually falls. In acute mastoiditis there is a speedy rise in the sedimentation rate, which then remains stationary for some weeks. In virulent mastoiditis or when a complication is threatening there is no stationary period but rather a continued rise. If this takes place, even in the absence of other symptoms, the author advises earlier operation.

The formation of abscesses or enclosed osteitic foci in the zygomatic or digastric region or in the pars petrosa causes a rise in the sedimentation rate, as do sinus thrombosis and meningitis. Labyrinthitis has little effect on the sedimentation rate.

A rise in the sedimentation rate accompanying or preceding a rise in temperature in the course of otitis, either before or after operation, is often due to an otitic complication. When the complicating condition is angina or some other intercurrent febrile disease, there is always first a rise in temperature and two to four days later a rise in the sedimentation rate.

A sedimentation rate of over 100 in an adult indicates almost without exception that the condition is operable. The same conclusion can be drawn with great probability in cases of children under 15 and with considerable probability in cases of infants.

GROVE, Milwaukee

PATHOLOGIC AND CLINICAL STUDIES OF THE SO-CALLED ZYGOMATIC MASTOIDITIS HAKAN R GADOLIN, Acta oto-laryng **26** 492, 1938

In 957 cases of mastoiditis Gadolin found 74 cases in which the cells in the zygomatic process and in the anterior portion of the squama were involved.

Temporal cells were most usually encountered in cases in which there was an extensive cell system in the mastoid process. Such cells were also encountered fairly frequently in cases in which the pneumatization of the mastoid process had been arrested. Usually the temporal cell system connected directly with the general cell system of the mastoid, but in about one seventh of the cases there was compact bone between the two. Gadolin considers the zygomatic and squamal cells as terminal cells of cell paths originating from the walls of the auditory canal and the attic.

In 39 of the 74 cases of zygomatic mastoiditis the clinical picture differed from that usual in mastoiditis, and in the remaining 35 cases the special zygomatic symptoms were latent. The most common symptoms of zygomatic mastoiditis were pains in the temple, swelling and tenderness in the temple and the cheek, edema in the eyelids, pain on mastication and moderate trismus. A sinking of the upper anterior wall of the canal is a sign of great importance.

In one case pus from deep cells in the root of the zygoma penetrated into the mandibular articulation and into the cheek. Meningitic symptoms were often present, due to penetration of pus toward the dura. Systematic lumbar punctures made in a consecutive series of cases revealed a pathologic cell count and increased pressure in the cerebrospinal fluid in all but 10 of the cases observed. (The author does not say in how many cases this observation was made.) The most common intracranial complications were extradural abscess and meningitis, abscess of the brain occurred in 3 cases and symptoms of petrositis in 4.

Clinical diagnosis of zygomatic mastoiditis was often possible only after the appearance of symptoms due to cortical or epidural penetration of pus from the temporal cells. A normal roentgenogram does not preclude the presence of zygomatic cells. The frequent occurrence of intracranial complications renders the prognosis of zygomatic mastoiditis more grave than that of the more common variety.

Thorough exposure and drainage of the inflammatory focus in the temple require an elongation of the retroauricular incision forward toward the linea temporalis, and in searching for the focus one must remember that not infrequently it is entirely separated from the rest of the cell system by apparently sound, non-pneumatized bone and also that occasionally the cells extend to the extreme upper portion of the squama, to the most anterior part of the zygomatic arch and into the root of the zygomatic process as far as the aperture of the eustachian tube.

GROVE, Milwaukee

MASTOIDITIS CAUSED BY PNEUMOCOCCUS TYPE III EINO VAHERI, *Acta oto-laryng* 26 631, 1938

Eino Vaheri studied 200 cases of mastoiditis in which operation was done in the university clinic at Helsingfors. He calls attention to the fact that the organism now known as *Pneumococcus* type III was formerly known as *Streptococcus mucosus*. Among Vaheri's material, 200 cases of mastoiditis, were 54 infections caused by the pneumococcus, and of these 48 or 24 per cent of the entire material, were due to *Pneumococcus* type III. The clinical picture of otitis and mastoiditis caused by *Pneumococcus* type III is well known. The initial symptoms are mild. The purulent discharge is of short duration or entirely absent. Only after a long time, sometimes months, do symptoms arise which denote involvement of the mastoid process. Before this there is a latent period, during which there are few symptoms but a steady destruction of bone. The infections were divided into the following types: the acute, in which there were 5, the subacute, in which there were 25, and the latent type, in which there were 15. The bulk of the infections, therefore, fall into the subacute or the latent type, in contradistinction to mastoiditis caused by the hemolytic streptococcus, which more usually assumes the acute form.

Vaheri's observations further indicate that *Pneumococcus* type III usually invades a bone which is well pneumatized and that it rarely occurs in mastoiditis

with poor pneumatization. This observation, he thinks, accounts for the fact that mastoiditis due to *Pneumococcus* type III is more prevalent in older persons in whom the cell system has expanded, than in younger. The fact that *Pneumococcus* type III so often invades a well pneumatized bone explains the frequency with which it involves the pars petrosa.

GROVE, Milwaukee

Pharynx

BEHAVIOR OF THE WHITE BLOOD CELLS AFTER TONSILLECTOMY G. PELLICCIA,
Arch ital di otol 51 84 (Feb) 1939

Recently Pelliccia studied the effect on the blood picture of massage of the tonsils. The most important finding was leukopenia. Investigation of the effect of tonsillectomy on the blood was next undertaken on 15 patients, in 10 of whom massage of the tonsils before the operation had been carried out. As controls he used 5 patients who had had other operations comparable in gravity to tonsillectomy. In 3 of the controls, appendectomy had been done. He discovered marked leukocytosis with an increase of neutrophils in the tonsillectomized patients, reaching its maximum five to seven hours after the operation and return of the preoperative value after twenty-four hours. The variation in the number of lymphocytes was in inverse ratio to the variation in the number of neutrophils. Operative trauma or toxicoinfective factors played a small part in causing the changes in the blood, which are attributed to the sudden suppression of an action, perhaps endocrine, of the tonsils. This action, however, is shared by other aggregations of lymphoid tissue. The same effect was produced on the patients in whom the appendix was removed, but not on the other controls. The postoperative leukocytosis in cases of tonsillectomy was of brief duration because of the vicarious action of other lymphatic organs.

DENNIS, San Diego, Calif

A DISCUSSION OF THE ACTION OF THE SOFT PALATE AND THE TUBAL ORIFICE DURING DEGLUTITION THEODOR MOTLOCH, Ztschr f Hals-, Nasen- u Ohrenh 44 359, 1938

The author reports a case of carcinoma of the upper jaw, in which, after operation, a large open cavity was revealed, extending into the nasopharynx and exposing the soft palate and the lateral and the posterior pharyngeal wall. He set up an unusual camera with special lighting facilities and was able to photograph the pharynx and eustachian orifice.

His observations were that during swallowing the soft palate moved upward to the posterior pharyngeal wall but that the posterior pharyngeal wall itself did not move. The plica salpingopharyngea moved backward and medially. The eustachian orifice (which normally had a craniocaudal slit) was widened, so that in its lower part it was flattened, and here there was a swelling below.

The widening was due to the action of the levator and the tensor veli palati muscle. The tensor muscle, which swings around the hamulus, spreads out in a radiating fashion into the aponeurosis of the soft palate, is united with the posterior membranous wall of the eustachian tube and, on contraction, draws the wall of this tube backward and downward, making it extend out horizontally. The levator muscle, the prominence of which also was noted below the orifice of the tube, assists in this action of widening the orifice and makes for better aeration of the eustachian tube.

PERSKY, Philadelphia

THE SIGNIFICANCE OF ATYPICAL VEINS IN POSTANGINAL SEPTICEMIA O. BRANKEL,
Ztschr f Hals-, Nasen- u Ohrenh 44 432, 1938

The author cites a case of septicemia following retrotonsillar infection complicated by phlebitis and thrombosis of the jugular vein. Tonsillectomy was performed with ligation of the internal jugular vein. This ligation was made 2 cm

above the facial vein and about a fingerbreadth above the clavicle. The common facial vein also was ligated. However, the patient continued to have chills and within two days died.

The postmortem examination showed atypical distribution of the left anterior jugular vein, which extended from below upward to lead into the posterior facial vein, then into the tonsillar bed and, high in the neck, into the internal jugular vein. In consequence of the anomalous distribution, the sepsis came down from the tonsillar bed into the posterior facial vein and, instead of going into the internal jugular vein, continued down into the anterior jugular vein. That was perhaps the reason that the ligation of the internal jugular vein did not benefit the patient or affect the course of the disease.

In conclusion, the author states that if in the course of postanginal septicemia ligation of the internal jugular vein, the common facial vein and other veins in the operative field fails to produce improvement of symptoms, particularly if chills continue, one must suspect that thrombosis may have affected either the external or the anterior jugular vein, and these must be investigated at a second operation.

PERSKY, Philadelphia

Larynx

PULMONARY COMPLICATIONS IN SURGICAL TREATMENT OF THE LARYNX AND PHARYNX P BROUSTET, *Rev de laryng* 59 713 (Sept-Oct) 1938

A lecture given in Prof G Portmann's course is summarized. The statistics from the French otolaryngologists are at variance with those obtained from other sources, particularly American. For example, 93 per cent of French otolaryngologists report that they have never seen any pulmonary complications following tonsillectomy. The author doubts the large number of complications reported in the American literature, although he admits the validity of the observations and the validity of the experimental work. The author notes the possibility of pulmonary infection following tracheotomy or partial or total laryngectomy or in the presence of a foreign body.

BATSON, Philadelphia

HARMONIC VIBRATIONS IN LARYNGEAL THERAPY J TARNEAUD, *Rev de laryng* 59:860 (Nov) 1938

For forty years vibration has been used as a method of treating laryngeal conditions. The subject of the present article is an apparatus which produces the eight frequencies of an octave from C-3 to C-4. This apparatus consists of an electric alternating current, an oscillator and an amplifier, with a simple electric applicator which transmits the emitted vibrations to the skin over the larynx. The keyboard allows a rapid change from frequency to frequency. The apparatus is especially recommended for aphonia due to psychomotor paralysis (hysterical aphonia) and for the psychasthenic vocal disorders of the singer. It is recommended for stabilizing the changing voice of the adolescent.

BATSON, Philadelphia

HEMANGIOMA OF THE TRACHEA LOTAR HOFMANN, *Ztschr f Hals-, Nasen- u Ohrenh* 44:435, 1938

The author reports the cases of 2 infants 2 months old, with hemangioma of the trachea. The symptoms, the clinical course and the pathologic picture were practically identical in each case. The peculiar type of stridor was characteristic of a laryngeal obstruction and seemed to improve on quiet respiration or sleep but became worse during any excitement or crying spell. The diagnosis was suggested by direct laryngoscopic examination. In addition, the author found evidences of hemangioma in other sites of the body.

He suggests local treatment and perhaps roentgen therapy or surgical intervention, but he doubts their value, since bronchitis and pneumonia may occur early and terminate the case

PERSKY Philadelphia

Nose

THE NOSE IN CASES OF ASTHMA J COURBIN, *Rev de laryng* 59 617 (July-Aug) 1938

The present status of knowledge of asthma, particularly as regards the symptoms in the nose, is reviewed. The nose as a "trigger area" is again emphasized. The usually practiced therapeutic procedures include topical applications to the nose, surgical treatment of the nose and desensitization by injections of protein. The author particularly emphasizes the good results obtained by visits to particular French watering places.

BATSON, Philadelphia

A SUBPERIOSTEAL OPERATION ON THE FRONTOETHMOID SINUSES BY A COMBINED INTRANASAL AND EXTRANASAL TECHNIC E J KAUNAS, *Rev de laryng* 59 766 (Sept-Oct) 1938

It is possible to drain the frontoethmoid sinuses successfully by an intranasal subperiosteal operation, however, in large sinuses extending far laterally the addition of an extranasal approach is necessary. Certain special instruments are recommended. For the most part these are the instruments commonly employed in radical surgical treatment of the sinuses, with the addition of the long-bladed retractors used in the external approach to the ethmoid cells. The patient is placed in the dorsal recumbent position, with the head slightly elevated. Local anesthesia is preferable. An endonasal 1.5 to 2 cm incision is made along the bony margin of the piriform orifice. Through this incision the skin and periosteum are elevated from the bony bridge of the nose as far as the upper internal angle of the orbit. The lacrimal sac is carefully pushed out of the way. Similarly the mucous membrane is pushed away from this piece of bone on the nasal side, and the intervening bone in a narrow strip is removed in several steps, as follows. First, with the piriform orifice as a starting point a narrow strip of the ascending process of the maxilla is removed, care being taken to preserve the inferior orbital margin. Next, the resection of the upper part of the ascending process of the maxilla is attempted. This bone is much heavier, and its removal is more difficult. The third procedure is the resection and removal under the control of vision of the small but heavy orbital portion of the frontonasal plate. Any bone obstructing the free approach to the nasofrontal duct is likewise broken down. Next, the ethmoid labyrinth may be everted by working from before backward with the forceps or from posterior to anterior with a curet. The sphenoid labyrinth is now open for inspection, and the mucous membrane may be removed by curettage.

For large sinuses an extranasal approach is necessary. An incision is made along the lower margin of the eyebrow, limited to the outer half to protect the vessels and nerves coursing along the inner half of the brow. By elevating the soft part with the periosteum, an entrance is made into the floor of the frontal sinus at its lateral extension, and the exposure is continued to a point of junction with the endonasal opening. The entire sinus may now be curetted from the combined approach. This procedure has been carried out in 18 cases. The advantages claimed over the usual methods of Jacques and Jansen are as follows. A greater opening is made into the frontal sinuses, the final esthetic result is better, there is less postoperative pain. The author feels that the method should be used only with patients with large extensions of the sinuses. The procedure allows more attention to be given to the soft part, and the author feels that the good results obtained are due to the careful preservation of the periosteum and its close return to the denuded part. The preservation of the periosteum without trauma provides for adequate irrigation of the parts by the normal blood vessels.

BATSON, Philadelphia

INFLUENCE OF THE METEOROLOGIC COMPLEX ON THE FREQUENCY OF EPISTAXIS
R. ABBATE, *Arch ital di otol* 50 689 (Dec) 1938

Abbate had previously studied the monthly and seasonal frequency of epistaxis in the quinquennial period 1921 to 1935 and found that the peaks of frequency occurred in winter (February), in summer (July) and in autumn (November), in the order of height. The present study was made for the purpose of determining what influence meteorologic factors during the same period may have had on the incidence of epistaxis. The only factors investigated were temperature, barometric pressure, storms, cyclones, winds, relative humidity and clear calms. It is shown that the cyclic course of epistaxis is in relation with the cyclic course of some of the meteorologic factors. The increase of epistaxis was found to coincide with the variations of temperature from the temperate mean values (15 to 20 C), the greater the variation the higher the incidence of epistaxis. Epistaxis was intensified during the period in which the thermometer, after having reached a minimum, turned upward, or the reverse. A rapid fall of barometric pressure was also accompanied by an increase in the number of cases of nasal bleeding, especially when it coincided with the thermometric factor. The influence of the other factors was of minor importance and was partly dependent on that of the two mentioned. Physiologic facts offer a sufficient explanation of the observations recorded.

DENNIS, San Diego, Calif

THE PNEUMATIZATION OF THE FRONTAL SINUS IN ATROPHIC RHINITIS WITH
OZENA. HERMANN BARTH, *Ztschr f Hals-, Nasen- u Ohrenh* 44 135, 1938

The author made a critical study of a series of cases of atrophic rhinitis and came to the conclusion that there is no positive evidence that atrophic rhinitis has any influence on the development of the frontal sinus. He traced the family history of 26 patients who had a suggestion of a hereditary element and found that there was no definite relation between ozena and the size of the sinus in any one family, that is, a mother and daughter might have a small sinus, while the son might have a large sinus.

Roentgenograms were made of 82 patients with atrophic rhinitis to determine whether the disease is associated with absence or poor pneumatization of the frontal sinus. Comparison with a control group of 300 normal roentgenograms of the frontal sinus suggested the possibility that with ozena the sinus may be slightly smaller, but the difference in size was too small to be conclusive. Hence the author concludes that the development of the sinus is not influenced by atrophic rhinitis.

PEPSKY, Philadelphia

THE AIR CURRENTS IN A HUMAN NOSE DURING RESPIRATION. J. SCHEIDELER,
Ztschr f Hals-, Nasen- u Ohrenh 44 228, 1938

The author constructed a rather ingenious model of the nose, in which the turbinates could be easily removed. The walls were covered with calcium. He constructed also an apparatus with which a measured amount of air under different pressures can be either blown or aspirated through this model. The air contained ammonium chloride, and as it passed through the model of the nose it etched its course on the calcium walls. In this way the author was able to trace the various air currents.

He noted that the air currents varied according to the amount of pressure going through the nose. A pressure of 128 liters per minute produced a current directed toward the anterior end of the middle turbinate. Here a small whorl was directed downward, which mixed with the main stream of the inspired air. The main stream passed in two equally large portions toward the upper border of the middle turbinate and the middle meatus, between the middle turbinate and the septum and then backward to the choana. If the pressure was less than 100 liters per minute, the stream was directed toward the agger nasi and then backward as in the foregoing observations, but a small portion produced a whorl in the vestibule.

of the nose Lowering of the air pressure still further not only lowered the arc of the major current of air but broke it up into an increasing number of whorls

He then removed the inferior turbinate, and with an air pressure of 128 liters per minute he found that only a small stream of air flowed upward and directly back into the choana The major portion of the stream struck the end of the middle turbinate and was then directed downward in a whorl toward the floor of the nose, where it stagnated for a while and then passed back into the choana

When he removed the middle turbinate and left the inferior turbinate in place, he found a much larger stream of air going directly back into the choana and only a small portion being deflected downward When he removed both turbinates, only a small portion formed an arc and passed to the choana, the larger portion was directed down toward the floor of the nose and there formed many whorls

In conclusion, he states that when one or both turbinates are removed, the course of the air flow is definitely altered, with the formation of eddies or whorls either in the vestibule or toward the floor of the nose In order to correct this, a greater amount of air pressure must be used to produce a sufficient amount of fresh air to pass back into the choana

PERSKY, Philadelphia

NASAL POLYPI AND EDEMA MITTERMAIER, *Ztschr f Hals-, Nasen- u Ohrenh* 44 239, 1938

The author discusses nasal polyposis from the chemical standpoint He found that the protein content of the serum ranged between 0.5 and 1 per cent, while the protein content of normal serum is about 7 per cent This seems to speak against the thought that the polyp was formed by stasis of the fluid He believes that it is probably due to greater permeability of the blood vessels

He suggests a simple test to determine the allergic response in cases of polyposis He injected 0.2 cc of physiologic solution of sodium chloride intradermally A small wheal was formed, followed by a secondary wheal The secondary wheal disappeared in about six to twelve minutes He measured both the size and the volume of this wheal In persons with hyperplastic states who show a tendency to edema and polyposis usually the secondary wheal does not occur, and the primary wheal disappears in a much shorter time than six minutes His conclusion is that persons who show a rapid resorption of the saline solution have a tendency toward polyposis, probably due to a certain degree of retention of salt in the skin

In treatment, he suggests a salt-free diet leaning toward the alkaline side of the acid-base ratio and a careful avoidance of any evidence of acidosis

PERSKY, Philadelphia

Miscellaneous

EXPERIMENTAL STUDY OF THE RELATION BETWEEN THE LABYRINTH AND VOMITING F VENTURA-GREGORINI, *Arch ital di otol* 51 1 (Jan) 1939

A prominent theory of the cause of seasickness is that it arises from an abnormal excitation of the vestibular apparatus It is not easy to explain the genesis of vomiting in seasickness, because the mechanism of the complex physiopathologic act of vomiting itself is still obscure The cardiac reflex has its seat in the pharynx and the upper part of the esophagus, the centripetal arc being formed by the glossopharyngeal and pneumogastric nerves and the centrifugal arc by the vagus The cardiac tonus plays an important role in the mechanism of vomiting, while it is easily inhibited by the act of swallowing, it opposes a marked resistance to regurgitation of the stomach contents, and a much stronger stimulus is required to relax it Volenti assumed that, in the act of vomiting, a not negligible stimulus must be supplied by the propagation along the esophageal walls of antiperistaltic waves that arise in the stomach By Volenti's method a graphic representation of the behavior of the cardiac emetic tonus is obtained Gregorini used this method in an experimental study on dogs to determine the

relation between labyrinthine stimulation and dilatation of the cardia. After laparotomy a glass tube was fixed in the wall of the stomach, behind which the pyloric end of the stomach was ligated. Attached to the tube was a recording manometer with a reservoir of fluid which could be raised or lowered to vary the endogastric pressure. The labyrinth was stimulated by means of galvanism and caloric irrigation of the inside of the bulla. The results of the experiments were that the cardiac, emetic tonus was not modified by the labyrinthine stimulation. The author concludes that the hypothesis that excitation of the vestibular apparatus is directly the cause of vomiting in seasickness is not supported by the experiments.

DLNNIS, San Diego, Calif

MONONUCLEOSIS INFECTIONA AND MENINGOENCEPHALITIS. VIGGO SCHMIDT and ANGE NYFELDT, *Acta oto-laryng* 26 680, 1938

Mononucleosis infectiosa was originally considered an infection of the throat with a peculiar hematic picture. It is now known that it is a general systemic condition always recognizable by typical hematic changes and that it may frequently be associated with a disease of the throat. In addition to the symptoms in the throat there may be other complications such as exanthems, hemorrhagic diathesis, albuminuria, icterus and, in isolated cases, serous meningitis and a form of encephalomeningitis. When this condition was originally described it was not supposed to affect the central nervous system.

In the course of two months Schmidt and Nyfeldt diagnosed mononucleosis infectiosa in 5 cases. Two of the patients entered the clinic with a diagnosis of sinus infection and tonsillitis, the other 3, with a diagnosis of peritonsillar abscess. In 4 of the 5 cases there was definite pharyngeal and tonsillar involvement, with cervical adenopathy. As the first patient presented definite signs of meningitis, the cerebrospinal fluid of the other 4 patients was also studied, although they did not present signs of localization in the central nervous system on entrance. In these cases the early lumbar punctures did not reveal much change in the cerebrospinal fluid, but when the culture was repeated later, after subsidence of the fever and the angina, a much higher cell count was obtained. The differential blood count in all 5 cases showed a striking reduction in polymorphonuclear cells and a marked increase in the lymphocytic elements. Cultures of the cerebrospinal fluid revealed in 4 of the 5 cases a pure culture of *Listerellae*. The observations in these 5 cases indicate that invasion of the central nervous system does occur in this condition, and usually late in the course of the disease.

GROVE, Milwaukee

ATTACKS OF MENIÈRE'S DISEASE AND ATTACKS OF IRITIS TOGETHER WITH ANGIO-NEUROTIC EDEMA OF THE LIDS IN THE SAME PATIENT. K. O. GRANSTROM and C. O. NYLEN, *Acta oto-laryng* 26 717, 1939

The authors present an interesting case, which tends to throw some light on the pathologic processes taking place in Ménière's disease. Their patient, a woman past 56, had presented for several years repeated attacks of the Ménière syndrome and also of palpebral edema of Quincke (angioneurotic), accompanied by iritis-like attacks of short duration. These were considered by the authors an "intra-ocular edema of Quincke," and the attacks of Ménière's disease were thought to be due to an analogous process in the labyrinth. All of the symptoms of this patient were considered allergic in nature, but a thorough allergic check-up failed to reveal the offending allergen. The patient was carefully examined between attacks and at such times was found to be normal in every respect, particularly in regard to the cochlear and vestibular mechanisms. During the Ménière attacks vertigo, rotary-horizontal nystagmus on change in the position of the head and a marked reduction of hearing in the left ear developed. The authors therefore assume that the "angioneurotic" edema affected both the cochlear and the vestibular end organ. Because of a positive Nonne reaction and a positive Pandy reaction of the spinal fluid they believe that the central portion of the auditory apparatus also was involved during the attacks.

GROVE, Milwaukee

Society Transactions

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY

THOMAS W. LEWIS, M.D., *President*

Regular Monthly Meeting, April 3, 1939

WALTER H. THEOBALD, M.D., *Secretary*

NASOPHARYNGEAL FIBROMA Presented by DR. STANTON A. FRIEDBERG

This article will appear in full in a later issue of the ARCHIVES

CEREBRAL EDEMA AS A CAUSE OF INTRACRANIAL HYPERTENSION OF OTITIC ORIGIN
Presented by DR. NORMAN A. LESHIN

The syndrome of increased intracranial pressure occurring during the course of middle ear suppuration but not associated with focal or diffuse intracranial inflammation is discussed. The signs and symptoms are those of intracranial hypertension, namely, headache, vomiting and papilledema, with absence of positive focal neurologic findings and the finding of normal cerebrospinal fluid under increased pressure. Differential diagnoses are set forth, and an extensive review of the literature is given.

The essayist reported in detail the case of a boy aged 10 in whom, as was indicated by the pneumographic and operative findings, increased intracranial pressure was due to an excessive amount of fluid in the brain itself rather than in the ventricles and subarachnoid spaces. In the literature, similar conditions with and without foci of suppuration in the temporal bone have been variously termed "serous meningitis," "hypertensive meningeal hydrops" and, rarely, "cerebral edema." It is suggested that the commonly accepted concept of otitic hydrocephalus is probably incorrect in many cases in which the term has been used, as the dilated subarachnoid channels and communicating hydrocephalus have not been demonstrated in most reported cases. Careful effort should be made to determine more accurately what type of intracranial disturbance is present. Should the hypertensive syndrome subside after simple lumbar drainage, it is suggested that the descriptive term "hypertensive syndrome" be applied. In cases in which there is no response to lumbar drainage and dehydrating measures, pneumographic studies (preferably ventriculographic) should be done.

In the case reported, persistent cerebral edema was found to be the cause of the intracranial hypertension, and the suggestion is offered that venous stasis due to infection in the dural sinuses might be the underlying cause. Cerebral edema may be a much more frequent cause of the otogenous hypertensive syndrome than is generally supposed.

DISCUSSION

DR. NORMAN LESHIN: For some years otolaryngologists have been confronted with a clinical syndrome associated with otitis media, which Symonds in 1931 suggested be termed "otitic hydrocephalus." The salient features of this syndrome are symptoms of increased intracranial pressure, namely, headache, vomiting and papilledema, without evidence of abscess formation and with spontaneous recovery. The pathologic nature was considered to be that of hydrocephalus due either to excessive secretion from the choroid plexus or to defective absorption from the arachnoid villi.

Now Dr Levy has definitely shown that this clinical syndrome can be produced by cerebral edema and that the pathologic background cannot be accurately determined unless thorough air studies are made. It is of great interest, further to note in the literature that most of the cases reported in which air studies were made small ventricles were revealed instead of dilated ventricles as one would expect to find in cases of hydrocephalus. In spite of this finding, both the concept and the title of this syndrome have remained unchanged.

Now there is presented a pathologic condition, cerebral edema, which can explain both the symptomatic complex and the pneumographic findings, as shown by Dr Levy in this report of a case with pneumographic studies and, on cerebral decompression, visual confirmation of the diagnosis of edema. It is peculiar, however, that in a fair number of reports of such cases in which subtemporal decompression was done the observers made no mention of cerebral edema. Davidoff and Dyke reported having done subtemporal decompression in 13 of their 15 cases of this type, without emphasizing cerebral edema. This may have been simply an oversight. On the other hand, it is still possible that this clinical syndrome may be produced by other types of pathologic involvement, as hydrocephalus, arachnoiditis or even a lesion of the posterior fossa. With these possibilities in mind, in cases in which the symptomatic picture is fundamentally the same it appears that air studies may be essential to determine the underlying pathologic changes. In those cases in which several spinal punctures clear up the condition, nothing further is required. On the other hand, when the syndrome persists, further investigative measures are necessary, as shown by Dr Levy.

The causative factor for this condition is not necessarily otitis media. In 2 cases the syndrome followed sore throat, and in 2 others it followed an infection of the upper respiratory tract. In some of the cases a relapse followed an infection of the upper respiratory tract. However, the large number of cases in which it has been associated with an involvement of the lateral sinus ranging from phlebitis and perisinus abscess to thrombosis of the sinus must place the condition definitely as one of the otitic complications.

The therapy has been, essentially, repeated spinal drainage and, with an obstinate condition, decompression. The papilledema gradually disappears over a period ranging from a few months to several years. In cases in which the headaches return, they usually respond to spinal drainage alone.

Dr Levy has shown the necessity for further study of this condition when both the etiologic and the pathologic features are in doubt. Pneumographic studies seem to be a definite step in the direction of an accurate diagnosis. Otologists who may be confronted with this condition should avail themselves of complete neurologic cooperation in an attempt to solve the problem.

Dr Levy has made a noteworthy contribution to knowledge of this subject. He has shown the necessity of pneumographic studies, and his suggestion for changing the name of this syndrome should be seriously considered.

DR HANS BRUNNER. The paper was very interesting, and I entirely agree with Dr Levy that the conception of "otitic hydrocephalus" as Symmonds described it has not been proved by the author to fit the facts. I personally have never been convinced by the deductions of Symmonds, although I have not been able to make an exact diagnosis in those cases of "otitic hydrocephalus" which I have observed. Undoubtedly it portends great progress that Dr Levy stressed the importance of encephalography in such cases. From the encephalographic examination in his own case Dr Levy draws the conclusion that he had to deal not with hydrocephalus internus but with edema of the brain, because the ventricles of the brain had a normal size and configuration and because following the subtemporal decompression the brain was found moist and edematous. I cannot quite agree with the last conclusion. Provided that the ventriculographic examination was performed prior to the subtemporal decompression, one would expect that the ventricles would be narrower than normal in a case of edema of the brain. One must imagine that the brain when it suffers from acute edema becomes

larger By this increase of size it would partly obliterate the arachnoidal spaces, but it would also bulge out into the ventricles Consequently the size of the ventricles would be expected to be narrower

However, it is only of theoretic interest whether the interpretation given by Dr Levy is correct or not From the practical standpoint, of greater importance are two other questions 1 How can these cases be differentiated from those of abscess of the brain? 2 How should the patients be treated? So far as the first question is concerned, three points seem to be of importance 1 Patients with edema of the brain are usually children or juveniles 2 In cases of "brain edema" there frequently can be noticed a sudden development and a rapid increase of choked disk, so that the papilla is elevated from 5 to 6 diopters within a few days Such a rapid swelling of the papilla occurs neither with abscess of the brain nor, as a rule, with tumor of the brain 3 Such patients do not give the impression that they are seriously ill, despite the marked changes within the eye-grounds, as already pointed out by Dr Levy

As far as the treatment is concerned, I have learned to be conservative in these cases When mastoiditis is present, the simple mastoid operation is performed and the dura, particularly that of the middle fossa, widely exposed When there are signs of an infection of the sinus, both the sinus and the dura of the posterior fossa are exposed Lumbar puncture is performed but not repeated too often To date I have never been forced to do a further decompression of the brain However, it is necessary that the physician should not become too apprehensive, since it sometimes takes many days for the choked disk to subside The physician has to bear in mind that in these cases, as well as in those of abscess of the brain, choked disk seldom changes into secondary atrophy of the optic nerve, as it frequently does in cases of tumors of the brain

DR R H GOOD Eighteen years ago I read a paper before this society on the subject of abscess of the brain and irritation of the brain, and I showed then the symptoms of hypertension which arise from extradural irritation caused either by pus or by toxin No matter where this necrosis is, it provokes hypertensive symptoms When one exposes the dura the symptoms disappear, except when the abscess occurs over the lateral sinus In this case, with the abscess producing either parasinusitis or thrombosis, one sees these symptoms of hypertension reappear and continue for a long time I object to spinal punctures in the treatment of hypertension in such cases

When I presented this paper Dr Beck had just come back from the war, and he discussed it and said that it was a "wonderful pedagogical paper" but that he did not think there was anything in the subject

DR JOSEPH C BECK I want to recall to Dr Good that when he presented that paper I attacked it, and he should have given vent to his feelings against me, because Dr Rogers, who was associated with him in that paper, was the surgeon I certainly was opposed to the attitude which these gentlemen took toward so many operations based on the symptoms alone and not on findings At that time roentgenography was in its infancy, and all one saw on the glass negative was a blur One must not confuse the present time with the past so far as the knowledge of this condition is concerned I am sure the society appreciates Dr Levy's study of this 1 case and his references to the literature as a whole

DR NORMAN LEVY I wish to thank all the discussers In reply to Dr Smiley and Dr Leshin, Davidoff and Dyke did not emphasize cerebral edema in their cases They described it but did not emphasize it They found an abnormal amount of cerebrospinal fluid over the convexity, but they also found the underlying brain to be edematous My idea is that it was the edema that was probably responsible for the small size of the ventricles which they uniformly found

In reply to Dr Brunner as to why the ventricles should not be smaller than usual, I cannot explain why I can only state the findings In the case I have described the cerebral edema was not hypothetic It was proved to be present when the decompression was done I agree with everything Dr Brunner said about the differentiation from abscess I think it is dangerous to wait too long

under certain conditions in the presence of papilledema. One must test the visual acuity and the visual fields frequently, because there may be changes secondary to those in the optic disk and permanent change in the acuity. If the impairment of visual acuity is progressive, subtemporal decompression should be done, because a very rapid change can occur in the course of a week or ten days.

In regard to Dr. Good's objection to spinal puncture, I can say only that in the majority of cases this cures the patient, and inasmuch as no harm is done, I can see no objection.

SIMPLIFIED CONSTRUCTION OF FACIAL MOLDS AND PROSTHESES (Demonstration with Colored Movies and Models). Presented by DR. SAMUEL PELUSE

The technic of making facial molds (life masks) as perfected by Dr. Fox and the essayist in the past two years was shown. The making of life masks is an essential adjunct to reconstructive surgical operation on the face and the construction of prostheses. The masks are accurate three-dimensional reproductions of the patients' faces and lend themselves to preoperative study, measurement and planning.

The models demonstrated were of wax and rubber. Wax models are hard to handle and difficult to store and are made only when a model has to be made rapidly. Liquid latex rubber is ideal for making models, as the resultant product tolerates rough handling and will not deteriorate. Of interest are the reproductions of temporal bones that have been operated on. In 2 models the exposed dura is represented, and when the model is palpated one gets the sensation of feeling the real dura. These models lend themselves very well to teaching purposes.

DISCUSSION

DR. JOSEPH C. BECK: I want to compliment Dr. Lederer on having developed the method to this perfection. It would be too bad to let this demonstration go without discussion. I have had a good many years of experience in making models for repair of defects about the face. My associates and I have done a good many things along the line of prosthesis with excellent results. This exhibit is wonderfully demonstrative—particularly of the pathologic character of the tissues involved. One cannot get by the appearance what can be obtained by the feel—for instance, in the temporal bone specimens it is possible "to palpate the dura." These models are very important and are interesting from the standpoint of operators. One may also have gross specimens reproduced to show pathologic features. The registry in Washington is very short of gross pathologic material, and this is going to fill a great need in working out these problems.

Dr. Peluse is to be congratulated on this work, which is much needed by otolaryngologists and others who are interested in radical exenteration of sections of the face in the treatment of malignant growths or trauma; they can have something to show the patient as to the end result when so much tissue has to be sacrificed.

DR. FRANCIS LEDERER: I rise to say that I cannot accept credit for this presentation. The work was done by Drs. Fox and Peluse with the help of Mrs. Peluse. My interest in this type of work goes back a number of years to prostheses (Lederer, Francis L. *Prosthetic Aids in Reconstructive Surgery About the Head*. Presentation of a New Method, *ARCH. OTOLARYNG.* 8: 531-534 [Nov.] 1928) as well as to material for teaching. In this regard, this work has filled a great need in the department of otolaryngology. Dr. Peluse is now making it a part of clinical teaching. Some may feel that such work is purely a technician's work, but I think it is important that otolaryngologists create an interest in this type of work, because it is an essential part of their specialty, not only from the point of view of teaching but also from that of replacement where there are gross defects. The period devoted to this was so short that many details were left out, but the exhibit is well worth study. Aside from the clinical application, the making of models is economical. The models are produced at small cost, are not easily broken and can be preserved.

Book Reviews

Diseases of the Nose and Throat By Charles J. Imperatori, M.D., F.A.C.S., and Herman J. Burman, M.D., F.A.C.S. Second edition, revised. Price, \$7. Pp. 726. Philadelphia: J. B. Lippincott Company, 1939.

The second edition retains the general plan and format of the first. Here and there a thorough revision of a chapter has been made because of the greater knowledge of the condition discussed accumulated during the past several years. An enormous amount of material is compressed in the 726 pages that this volume contains.

The authors again depart from the usual textbook description of disease by discussing first the symptoms, diagnosis and treatment and concluding with the pathology, prognosis, etiology and prophylaxis. Throughout the text they have endeavored to present the material in a clear, concise and comprehensive manner, in all of which, it is evident to the reviewer, they have admirably succeeded.

General systemic diseases with rhinologic manifestations are covered in twelve pages, allergic diseases in ten and laboratory aids in thirteen, and fuller discussions of hemorrhage of the nose and throat and particularly of postoperative submucous resection and tonsillectomy are presented. Descriptions of many of the recent advances have been added to the sections on the nose, and additional material will be found in the parts dealing with diseases of the oral cavity.

The accomplishments of the authors make this textbook authoritative. It is recommended to medical students, general practitioners and otolaryngologists and to specialists in subjects closely related to diseased states in the nose and throat.

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SURGICAL TREATMENT OF DEAFNESS

WALTER HUGHSON, M D

ABINGTON, PA

During the past three years otologists have been considering their deafened patients from a new and rather startling point of view. Sympathetic acceptance of the disability, followed by the institution of routine forms of treatment, has given way to a spirit of curiosity and an eager hope that something of more substantial benefit may be accomplished. This feeling has developed as a result of the reports of series of cases in which surgical treatment was adopted. After years of effort and persistence in the development of reasonable surgical technics, surmounting almost insuperable anatomic difficulties, the pioneers in this field of surgery have contributed something to knowledge of deafness which promises to revolutionize every previous concept of therapy.

At the moment otologists are almost as eager to grasp at any straw as are the victims of impaired hearing. Which of them has not seen dozens of patients who have "gone the rounds," thinking little of time or cost, in their eager search for relief? It is remarkable that with frequent disappointment these persons can retain hope, and it is in no way strange that many others become disillusioned and depressed at the complete inadequacy of present methods of treatment.

There is one encouraging factor in the otologist's enthusiasm for the new type of therapy—his appreciation of ineffectiveness of present efforts. But of even greater importance is the knowledge that certain persons in this highly specialized field of medicine are devoting their time and energy in an effort to rationalize and perfect the technic of surgical intervention for deafness. Unfortunately this object will never be completely attained in the laboratory, either by the study of pathologic sections or by experimental means. The final proof of any fact, however scientifically evolved by experimentation, will rest on the actual effect of its application on a person with impaired hearing.

Pioneers in the delicate surgery of the ear can protect themselves and their patients only by the thoroughness of their own training and

From the Otological Research Laboratory, Abington Memorial Hospital

Read before the Clinical Society of the New York Polyclinic Medical School and Hospital, New York, March 6, 1939

their method of selecting appropriate cases. There is no lack of eager candidates for operation, indeed, patients may even demand it, going from one surgeon to another until some operation is finally performed, regardless of whether there is reasonable hope of success. But it must be remembered that a new type of surgical intervention has never evolved without bitter disappointments for both patient and surgeon and infrequently without tragedy. One has only to recall the early days of cranial surgery to be impressed with this fact. However, the present status of the surgical treatment of deafness, an outstanding achievement of patience and skill, should hold real hope for those concerned.

A historical review of the attempts to correct defects in hearing by surgical means is hardly necessary at this time. Nor is it necessary to mention the various procedures employed, as the facts have been described in detail by numerous authors in the past few years. From simple myringotomy, first performed for deafness by John Hunter in the eighteenth century, to the surgical procedures of the past and the present century is a far cry indeed and, as Holmgren¹ said, "all such efforts were doomed to failure until asepsis and anesthesia became available." After the appearance of these two revolutionary safeguards to surgery in general, otologists again turned their minds toward the fascinating field under discussion. The pioneers, of necessity, met with discouragement and either abandoned their effort voluntarily or were forced to do so by the adverse criticism of their professional colleagues. At the beginning of the present century active interest was resumed and it has continued with increasing enthusiasm and with reasonable promise of success up to the present time.

The microscopic pathologic picture of the clinical entity otosclerosis formed the basis of all surgical methods developed during the years from 1917 to 1930. In the past decade revolutionary methods of studying the physiology of the auditory end organ as a whole or of any of its component parts have given a sound basis for concept of function. Again, there is no reason to enumerate these methods of study in detail. Many investigators have devoted their entire time to the newer types of research, using a variety of methods, singly or in combination. Conclusions have not always been in agreement, but the elaborate and complicated technical procedures employed made inevitable such seeming disparities in observed results. There can be little doubt that when the mass of material has finally been completely sifted and analyzed a sound and true foundation will have been laid for the structure on which the physiology of hearing is built. At the present moment it can be

1 Holmgren, G. Surgical Therapy in Otosclerosis, in Nelson Loose-Leaf Surgery of the Ear, New York, Thomas Nelson & Sons, 1938, chap. 18, pp. 399-430.

said without qualification that the theories already evolved experimentally conform directly to the normal and pathologic functions of the human auditory apparatus

Interest in the prevention, alleviation and possible cure of deafness can no longer be confined to impairment resulting from otosclerosis. Any departure from normal auditory acuity, whether conductive, neural or combined, must now be scrutinized with an eye toward adopting some type of surgical or radical treatment when all forms of conservative therapy have failed.

STANDARD OF OPERABILITY

To any conscientious otologist the criteria which must be satisfied before the institution of a surgical procedure are self evident. A complete toilet of possible septic foci must be carried out. This is largely a preventive procedure against further progress of the deafness, as an impairment already present is seldom corrected by such general measures. In the past few years many causes of deafness have been newly recognized. These are largely constitutional, general systemic disorders or obscure toxic involvement of the neural mechanism of hearing. Whether direct therapy will be availing or not, the presence of the condition must at least be recognized.

As stated, had direct therapy not proved unavailing after many years of trial, there would not be the present great interest in the newer, surgical, approach. Inflation and bougienage are still more or less universally employed with little regard to the rationale of the procedure. Certainly observation of the patients so treated gives one little reason to feel that the measure is either preventive or curative.

When conservative measures have proved unavailing and the loss of hearing has become a distinct disability, every patient should be prepared to use a hearing aid, whether surgical intervention is contemplated or not. A reasonably long and large experience in prescribing and fitting these instruments indicates that the formerly universal repugnance to their use is on the wane. Patients are now more easily convinced that continued application in their use will bring the desired effect and that the disagreeable qualities of the instruments will become less apparent. Should surgical measures fail, lip reading and a hearing aid may well be the last resort. To become proficient in lip reading after the third decade is a difficult task, a properly prescribed hearing aid is an immediate help to any one with a modicum of residual hearing.

Much is said of the patient's psychologic reaction to an unsuccessful surgical procedure. But what of his psychologic reaction to years of futile treatments? When operation is proposed, the surgeon is a priori faced with a problem in psychiatry, which has been building up for years in many cases. Must all radical treatment be abandoned because

operative failure deepens an already profound depression? Far better for the practicing otolaryngologist to recognize this almost inevitable development at the very onset of the deafness, when conservative measures are instituted, and fortify the patient against impending disappointments and discouragements. Friesner and Druss² showed the futility of inflation and bougienage, but, despite their authoritative exposition, the universally futile practice continues. Operation is at the present time the last hope from a therapeutic standpoint, but it is hardly fair that the surgeon should bear the full blame for the unhappy mental state. May not one rehabilitation of a deafened person offset the psychologic effect of several failures? Certainly it is more than any other present type of treatment can accomplish.

SELECTION OF CASES FOR SURGICAL TREATMENT

As mentioned, most surgical efforts designed to correct impaired hearing have been concerned with otosclerosis, and various diagnostic standards have been set up whereby this condition may readily be recognized. In general, such a diagnosis is now made simply on the basis of progressive loss of hearing beginning in the third or fourth decade and associated with tinnitus, lack of marked involvement of the drum-head and relatively normal bone conduction, the last being taken as an indication of a normal neural mechanism. This diagnostic picture is in reality too simple and too easy of fulfillment in any considerable group of deafened persons to be differential. Issue is here being taken only with the diagnosis otosclerosis. It is possible that in many cases of simple conductive deafness, uncomplicated by an acute suppurative episode, all the requirements might be fulfilled. In young persons, particularly, it is unlikely that the neural elements of the ear have been affected. An experimental study of bone conduction reported in 1936³ indicated conclusively that bone conduction can be impaired by many conditions other than damage to the neural mechanism of the ear. Crowe and Baylor⁴ recently reported cases of chronic otitis media in children in which markedly impaired bone conduction returned to normal when the otitis was successfully treated. His method of estimating bone conduction is not a matter of record. The extraordinary variability of bone conduction in children is not mentioned and cannot, therefore, be

2 Friesner, I, and Druss, J. G. Critique of the Present Treatment of Deafness Due to Lesions in the Conduction Mechanism, *Arch Otolaryng* **26** 259-267 (Sept.) 1937

3 Hughson, W., Thompson, E., and Witting, E. G. An Experimental Study of Bone Conduction, *Ann Otol, Rhin & Laryng* **45** 844-858 (Sept.) 1936

4 Crowe, S. J., and Baylor, J. W. The Prevention of Deafness, *J. A. M. A.* **112** 585-590 (Feb. 18) 1939

accepted as an important diagnostic factor. The observations do not necessarily constitute evidence of neural damage and hence are of small diagnostic importance.

Mobile tympanic membranes and patent tubae auditivae also may be required before operation is undertaken. Inspection of the membrane is usually sufficient to determine its mobility but not that of the ossicular chain or the footplate of the stapes. May not concurrent conditions of all these organs deprive an otosclerotic patient of the possible benefits of operation?

A diagnostic routine is therefore of more importance than the ultimate diagnosis, for by establishing such a routine otologists may make it possible to place many patients in the operable group, and by the same token many will be spared inappropriate and unnecessary operation. Such a diagnostic procedure might be outlined as follows, with the admission that the necessary physical equipment may be available to only a limited number of otologists.

Insistence must be made on repeated preliminary audiograms, certainly no less than three and preferably more. This is not to train the patient in accuracy of response but to establish the expected variation. Recent studies have shown that trained persons with relatively normal hearing may show a variation in response comparable to that of an untrained deafened person. The variation in the specific case must be established for air conduction, and the same attention must be devoted to an accurate analysis of bone conduction. Without entering into a discussion of the relative merits of tuning forks and electric devices for testing bone conduction, it may be said that the latter have been found to demonstrate with great accuracy the status of the patient's hearing by bone conduction. Indeed, within certain limits it is possible to obtain repeated bone conduction audiograms as accurate as those for air conduction. Masking is taken as a matter of course, particularly when there is any wide divergence between the relative acuity of the ears for hearing by air conduction. It is not enough to say, however, that masking has been used. Its type, intensity and method of application must be specified. Reference from the midline can usually be predicted, but, when it is investigated, it should be determined for all frequencies, as transference from one side to the other may develop with a change in the pitch of the stimulating tone. With what degree of impairment can one still hope that some useful hearing may be obtained from a successful operation? In reported series 25 decibels in the critical frequency range seems to be the maximum gain obtained with any degree of consistency. Therefore, a loss of more than 50 decibels in the same frequency range seems to make operation impractical. There may be, however, a legitimate leeway if certain frequencies have been spared in the general downward trend. An operative procedure cannot be

counted on to restore the perception of the two higher frequencies in the audiometric scale to any semblance of a normal level

Having determined the elementary facts, one should proceed to tests of greater differential significance. Of these, by far the most important is the loudness balance between the two ears, provided the disparity in acuity between the better and the poorer ear is at least 15 decibels. This standard is set because in certain cases the variation in accuracy may be as great as 15 decibels. Regardless of determination of bone conduction, Fowler's⁵ constant or variable response conclusively indicates conductive or nerve deafness, respectively. Bone conduction alone can no longer be regarded as a standard means of estimating nerve deafness.

If the footplate is definitely fixed, moderate pressure exerted on the tympanic membrane and thence transferred to the ossicular chain should not reduce the acuity of hearing. Conversely, if such pressure were exerted on a free footplate it would surely affect the response. It has been shown experimentally that changes of less than 5 mm of mercury in middle ear pressure have no effect on hearing.⁶ Such measured pressures may be applied to the external surface of the tympanic membrane and their effect on the acuity of the ear determined by means of a receiver attached to an ear speculum, while the air pressure in the external canal is controlled and measured manometrically.

Fatigue tests have proved of value in differentiating between conductive and nerve deafness. In an ear impaired by a conductive lesion, fatigue will not develop, when the impairment is purely neural, fatigue after stimulation of high intensity is inevitable.⁷ The fatiguing tones may be used at an intensity 85 or 90 decibels above threshold without risk of damage to the ear.

Finally, thresholds of intelligibility must be determined in all cases in which it is possible to operate, for they indicate postoperative improvement more clearly than do threshold estimations of individual frequencies. This procedure, it is hoped, will meet one of the severest criticisms of reported operative improvement.

In any discussion of the surgical treatment of deafness it must be understood that consideration is directed solely to those cases in which

5 Fowler, E. P. The Use of Threshold and Louder Sounds in Clinical Diagnosis and the Prescribing of Hearing Aids. New Methods for Accurately Determining the Threshold for Bone Conduction and for Measuring Tinnitus and Its Effects on Obstructive and Neural Deafness, *Laryngoscope* **48** 572-588 (Aug.) 1938.

6 Thompson, E., Howe, H. A., and Hughson, W. Middle Ear Pressure and Auditory Acuity, *Am J Physiol* **110** 312-319 (Dec.) 1934.

7 Hughson, W., and Witting, E. G. An Objective Study of Auditory Fatigue, *Acta oto-laryng* **21** 457-486, 1935.

no suppurative disease is present and in which there is no reasonable possibility of an acute infection developing. Of course, this presupposes an intact tympanic membrane. When a patient is presented for surgical intervention the routine rhinolaryngologic procedures have been carried out. Every possible source of infection should, however, be carefully checked. Special examinations and laboratory studies should be made when indicated, and a patient should not be operated on before the Wassermann reaction of the blood has been reported negative.

At this point emphasis must be laid on a thorough search for abnormalities of the blood vessels, such as hypotension, particularly in allergic states, hypertension, whether of old age or not, endocrine disorders and nutritional deficiencies. Although the treatments suggested for these conditions have received but poorly controlled observation, they must be assayed in any adequate diagnostic study. At the moment specific therapy for them has proved of little practical importance. A number of patients, women particularly, present the classic picture of pituitary-adenohyoid adenopathy. The influence of drugs on hearing is assuming greater importance in every thorough clinical survey.

The actual disability resulting from almost identical losses varies in different persons, perhaps because of occupation, temperament or any of a variety of conditions, and often the advisability of treatment depends more on apparent disability than on the actual audiogram. A direct corollary, the economic importance of the deafness, must be investigated and weighed. If immediate restoration of hearing is essential to maintain a position of economic independence, surgical intervention has no place, and the patient must be persuaded to resort to an appropriate hearing aid. However, if time is not so important a factor, operation may be attempted even though the hearing aid may eventually become necessary.

Emphasis on the influence of heredity seems to be slightly overdrawn. Certainly many patients are seen who have no significant familial background for their deafness, and even when deafness has been present in preceding generations, careful inquiry may demonstrate a tendency toward suppuration rather than any specific disease of the otic capsule. To maintain the incidence of deafness in the general population a few members of almost every family must have some impairment of hearing.

STANDARDS FOR AN OPERATIVE PROCEDURE

The very structure of the human ear, the seclusion of its more vital parts in the temporal bone, precludes the use of the term "simplicity" in connection with any surgical approach for the correction of impaired function. Any operative procedure can be made simple only by the technical proficiency of the operator. There is no need to emphasize

this fact here, yet standards must be set to insure the maximum of simplicity attainable in any proposed procedure. Whether technical proficiency is gained in the laboratory or on the cadaver, the technic must be second nature to the operator before it is applied to the human patient. This is a new type of surgical procedure, dealing with minute but vital structures and conducted in a field in which infection of low grade is probably the rule rather than the exception. No greater tribute can be paid to the pioneers in this branch of otology than to recall the relatively insignificant incidence of infection in the cases reported, which must be attributable not wholly to the aseptic technics employed but more to the meticulous delicacy used in handling tissues and to the observance of strict hemostasis, both cardinal principles of true aseptic surgery.

When he accepts the responsibility of operative treatment the surgeon wishes, of course, to promise some degree of lasting improvement, particularly for young persons. Yet at the present moment it seems hardly likely that any surgeon can make this promise on the basis of any series of cases reported, no matter what procedure has been employed. Although restoration of useful hearing cannot be definitely promised, at least the operation must not involve any possibility of further impairment. Infection cannot always be avoided in any field of surgery, and should it occur in the course of an operation for deafness the result would be disastrous. With full knowledge of this possibility, the patient must be the one to assume the risk. Reasonable assurance that the operation will tend to fix the hearing at its present level in itself justifies operation in cases of moderate impairment of hearing. All deafness is progressive up to a certain point, where it may remain static for years until the factors of age are superimposed on an early acquired impairment. This point cannot be accurately forecast, but in most instances the general loss lies in the rather broad range between 40 and 60 decibels. Unhappily for its success, surgical treatment of deafness is a last resort, seldom sought by the patient or made available by the practicing otolaryngologist, while the loss is between the theoretically most favorable levels, 25 and 40 decibels. Undoubtedly, when the surgical treatment of deafness has become more thoroughly established, operation will be advised when reasonable improvement might mean restoration to a hearing level approximating the normal.

OPERATIONS AVAILABLE AT PRESENT AND THEIR RATIONALE

There is probably no practicing otolaryngologist in the country who is not familiar, in some way, at least, with the procedure of fistulization of the semicircular canals, dramatic alike in the painstaking development of its intricate and skilful technic and in its extraordinary immediate effect on hearing.

Bárány and Jenkins, first, then Holmgren, the real pioneer, followed shortly by Sourdilles and more recently by Lempert, who simplified the procedure and perfected the technic, focused attention on this operation, characterized by implication, if not by title, as a direct treatment of otosclerosis. Insistence on this point may well affect the integrity of the entire procedure. The requirement of normal bone conduction is certainly a safeguard against promiscuous surgical intervention, while observation of the other standards already mentioned cannot help but favor a successful outcome. Holmgren¹ stated that otosclerosis is a progressive disease and hence renders the continued usefulness of a hearing aid unlikely. Would not this same argument hold true of fistulization if it is to be employed only for otosclerosis? It is well known that the disease may involve the walls of the canals or completely obliterate the scalae in cases of extreme involvement. What purpose would a fistula serve under such circumstances? It would seem that the operation must be too important to be restricted in application by a single point of differential diagnosis.

The rationale of the procedure is hardly clear—"decompression of the labyrinthine perilymph," "relief of venous stasis by decompression of the dura of the temporal lobe," "establishment of a new window covered with a thin, flexible membrane facing toward an air-filled cavity" and "a radical operation cavity or a greatly enlarged canal, as in the endaural approach," are all listed as the standards of successful operation. It is difficult to understand why fistulization of the promontory has failed to give results comparable to those of the same procedure carried out on one or more of the canals. Holmgren, though reporting immediate improvement in some cases, abandoned this approach after closure of the fistulas. There is considerable diversity of opinion among the surgeons performing the operation as to the relative importance of the various steps. Certainly the fistula must remain open. Whether Lempert's⁸ use of the polishing burr, filling the haversian canals with bone dust, is the answer to the problem remains to be seen. The final results of Holmgren's experiments with radium, mesothorium or platinum wire as a foreign body will be awaited with the greatest possible interest.

The disposition of the ossicular chain or of any individual ossicle is apparently a matter of less complete agreement than any other. If removal of the head of the malleus results in greater freedom of movement of the membrane, why will not complete removal of the incus serve the purpose as well if not better and endanger the intact tympanic membrane less? Is mobilization of the membrane over the fistula

⁸ Lempert, J. Improvement of Hearing in Cases of Otosclerosis. A New, One Stage Surgical Technic, *Arch Otolaryng* 28 42-97 (July) 1938.

an essential feature of the operation? Again, long experience alone will clarify these rather unsettled problems

If the reported improvement in hearing is found to be maintained over substantial periods, if the preponderant improvement of the thresholds for the lower frequencies gives useful gain in intelligibility and if the patients can be economically rehabilitated, then the future of the deaf is no longer completely dark

In contrast to this difficult though dramatic operation, the procedure first attempted in 1931, abandoned, and revived in 1937, fixation of the membrane of the round window with a tissue graft, is relatively simple.⁹ The operation is technically easy. In the small series, 35 cases to date, there have been no infections, no patient has suffered further impairment, all frequencies have been affected and the maximum useful improvement obtained is as great as that reported for fistulization in any case. The effect is slow in developing, but when once begun it has continued to the limit of time any case has been observed, two years.

In every case observed the drum membrane has healed without significant scarring and with little increase in retraction. In a few cases a small area of atrophy has appeared, after five to eight months, at the site of the incision or at points where small segments of the membrane have actually been resected to facilitate exposure of the niche of the round window. There is no need to elaborate again the technic of this operation except to emphasize that magnification and brilliant illumination of the field are essential to its proper performance. The patients are hospitalized three days and can return to work on the fourth day.

Normal bone conduction is not a prerequisite of operability, for if the often repeated rationale of the procedure holds—and there is no reason to think it unsound—any intact neural elements will receive a more intense stimulation following contraction of the graft in the niche and the total hearing should consequently be increased. Both ears have been operated on in 3 patients, this being done when the original or poorer ear had attained a lower threshold than the better ear. The second operation is not done until a year has elapsed.

The effect of the operation is not that of simple myringotomy, as has been suggested. During the so-called operative period—while the tympanic membrane remains open—either immediate improvement or impairment may result, in this series 80 per cent of the patients showed impairment while 20 per cent showed definite improvement. When impairment results, return to the preoperative level occurs shortly after the closure of the drum membrane. Audiograms are made every other day during the operative period.

⁹ Hughson, W. Rationale, Technique, Case Reports and Observations with Grafts in the Round Window, *Laryngoscope* 48 533-545 (Aug.) 1938

Another phenomenon of interest noted during the operative period, provided it lasts for two weeks or more, is the vascularization of the graft. By the end of the first week it becomes strikingly pale, while by the end of the second week color is restored and if it is touched with a probe there will be slight though definite bleeding.

In relation to this procedure one point of importance must be emphasized. Whether improvement results or not, the anatomic relations of the middle and inner ear have not been disturbed in any way. If necessity arise, a second operation of any sort could be carried out as easily as on an intact ear. In no published report of fistulization has it been mentioned that patency of the foramen rotundum is necessary. This fact seems to be of considerable importance.

At this point a suggestion will be made which is doubtless open to considerable criticism. When an unusual audiogram is presented, unexplained by otoscopic examination, it seems entirely proper to perform an exploratory myringotomy for diagnostic purposes alone. The risk is insignificant, no greater than that of a routine bougienage, and the information gained may well be the means of devising some useful procedure for a second operation.

Inspection of the middle ear through a wide posterior incision often reveals conditions which were totally unexpected before operation, such as peculiar excrescences on the surface of the promontory or abnormalities in its shape and size. No two round window niches are the same in angle of presentation, contour or diameter. Unexpected filmy adhesions may be present, division of which is probably of slight avail although, as in the abdominal cavity, newly formed adhesions may not exert quite so harmful an effect as those just sectioned. Adhesion of the tympanic membrane to the promontory can readily be corrected, but reattachment promptly occurs, usually with firmer and broader involvement.

Experience with sectioning of the tensor tympani tendon has been entirely disappointing. This is particularly true after observation of the marked effect tension of this muscle has on acuity of hearing in the experimental animal and how readily the impairment may be corrected by relief of the tension.

A discussion of the surgical treatment of deafness would not be complete without mention of section of the vestibular division of the eighth nerve in Ménière's disease and the subsequent improvement in hearing. In the light of Hallpike's microscopic observations on two of Cairn's patients,¹⁰ there seems to be no causative connection between operation and improvement in hearing. These pathologic observations

¹⁰ Hallpike, C. S., and Cairns, H. Observations on the Pathology of Ménière's Syndrome, *J. Laryng. & Otol.* **53** 625-654 (Oct.) 1938.

require confirmation, however, as experimental data indicate an absence of untoward effect in the presence of increased intralabyrinthine pressures. Dohlman's suggestion that collapse of the wall of the vestibule on the cupola may be responsible for the attacks of vertigo in Meniere's disease falls more in line with the experimental observation that marked decrease in intralabyrinthine pressure causes impairment in acuity of hearing.

This discussion has had a twofold purpose: first, to sponsor with enthusiasm the general principle that in the surgical treatment of deafness lies the future of this part of the otolaryngologist's endeavor, second, by pointing out the burdensome problems of selection and the difficulty of attaining technical proficiency, to keep enthusiasm within bounds and avoid the unhappy result of too ready a resort to surgical intervention. If air conduction is not further impaired and bone conduction is unaffected, as seems to be the case with fistulization, resort can always be made to one of the many electrical hearing aids now available. In the case of the graft in the round window, which does not require normal bone conduction and following which there has never been further loss of hearing by air, the ultimate usefulness of an air conduction aid is in no way impaired. The patient whose condition is appropriate is entitled to the possible improvement which these procedures offer. However much experimental investigation may eliminate the partial darkness in which the rationale of either operation lies, the ultimate elucidation of the problem now rests on clinical observation. The hazards of the methods so far do not seem to be great. Duration of improvement can be determined only by further time. But the entire structure will collapse unless supported by consistent and painstaking follow-up examinations, in which the otologist should use every means available to arrive at an objective measure of the restoration of hearing obtained rather than depend on subjective reactions, tempered as they so often are by a state of elation almost psychopathic.

FURTHER EXPERIMENTS IN THE ACTION OF DRUGS ON THE NASAL MUCOSA

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The following report is supplementary to one of a similar nature made a few years ago¹ The original communication dealt with the effects of several of the more commonly used drugs on the ciliary activity of the nasal epithelium Four of the drugs the effects of which are described at this time are in general use, four others are not now part of the rhinologist's pharmacopeia but are included here for other reasons, which will be explained

The methods employed in these investigations are practically identical with those which are described in detail in the first paper As in the first instance, three parallel series of experiments were done, the first on the living animal membrane undisturbed in the sinus, the second on material extirpated from animals and the third on material extirpated from the human nose When the results of these three are identical, it is felt that they may reasonably be applied to the living human membrane

I AMPHETAMINE (BENZEDRINE SULFATE, ALPHAMETHYL- PHENETHYLAMINE SULFATE)

Observations were made on the nasal ciliated epithelium (1) of the living rabbit, (2) of extirpated rabbit mucosa and (3) of extirpated human mucosa, with the use of (1) benzedrine inhalers without oil of lavender and with oil of lavender and (2) 1, 2 and 3 per cent solutions of amphetamine in liquid petrolatum

The effectiveness of the ciliary apparatus depends on the rapidity and amplitude of the ciliary beat, provided that the mucous coating is normal in viscosity Application of granular material is not necessarily a reliable indicator of ciliary activity, as variations in adsorption and specific gravity may effect the result

In all cases the active epithelium was observed under the microscope by reflected illumination, and the test substances were introduced

Read at the meeting of the American Laryngological Association, Rye, N Y, May 26, 1939

1 Proetz, A W The Effects of Certain Drugs upon Living Nasal Ciliated Epithelium, Ann Otol, Rhin & Laryng 43 450-463 (June) 134

through a specially constructed double capillary tube, which keeps the cilia in view at all times during the application. This device consists of two glass tubes welded together and drawn to a double capillary point. One tube is connected to a constant vacuum line. The test substance is introduced into the other tube and allowed to flow by gravity onto the membrane. The vacuum tube picks up the droplets as they strike the membrane and restricts the substance to a small area. This restricted application has a twofold advantage. First, it prevents overflow into the nose and choking and guards against poisoning the animal by flooding the trachea or the digestive tract with the test solution, second, by keeping the surrounding areas intact it provides controls adjacent to the areas under scrutiny.

A. Inhaler—The inhaler was attached through adaptors and rubber tubing to one arm of the capillary tube. The control current of air was first passed through the adjacent tube for two minutes to make sure that the drying effect was not sufficient to stop the cilia. At the end of this time the air was allowed to flow through the inhaler, projecting its fumes against the membrane. This stream of vapor was interrupted only occasionally for the purpose of moistening with Locke's solution as required by the drying of the surface of the control area.

1 Plain Amphetamine (Without Oil of Lavender) (a) Living rabbits. Rabbits were anesthetized by intravenous injections of sodium amytal, which instillation had been shown in previous experiments not to affect the ciliary beat, at least for the duration of the present experiments. The frontal sinuses were opened, and the cilia of the undisturbed epithelium were observed under the reflecting microscope. The capillary tubes were introduced into the field and a current of amphetamine fumes allowed to flow on the membrane. There was no appreciable change in the amplitude or rapidity of the ciliary beat at the end of twenty minutes, when the experiments were terminated. This was true in every case. Six observations were made.

(b) Extirpated membranes from the nose of the rabbit. Strips of nasal membrane from the septum, turbinates and lining of the sinuses of the rabbit were examined in a manner similar to that described except that the membranes were examined in small, flat glass dishes, the Locke solution in which they had been immersed having been withdrawn just previous to the experiment. Here again there was no demonstrable effect after twenty minutes. Six observations were made.

(c) Extirpated human tissue. Epithelium from the pharyngeal tonsil removed from children at operation for adenoids was examined similarly. In no case was there any appreciable change after twenty minutes. Six observations were made.

2 Amphetamine with Oil of Lavender (Benzedrine Inhaler) The experiments described in section "1" were repeated, the benzedrine inhaler with oil of lavender being used. The results were identical with those of the foregoing experiment. The number of observations was as follows: (a) on living rabbits, 2, (b) on extirpated rabbit mucosa, 2, and (c) on extirpated human mucosa, 2.

B *Amphetamine (Direct Application)*—The following results were observed:

1 The pure drug applied to the mucosal surface stopped all ciliary motion instantly.

2 A 1 per cent solution in liquid petrolatum caused slowing in a variable number of minutes, beginning in from three to seven minutes and persisting over the period of the experiment.

3 A 2 per cent solution in liquid petrolatum caused appreciable slowing within a few minutes after application, which occurred in varying degrees over the field, some areas being less affected than others but motion in all areas slowing to 3 to 6 beats per second.

4 A 3 per cent solution in liquid petrolatum caused general slowing and cessation in from three to six minutes, few areas being active at the end of that time.

The number of observations was as follows: (a) on living rabbits, 9, (b) on extirpated rabbit mucosa, 12, and (c) on extirpated human mucosa, 8.

Comment on the Observation of Oily Solutions. There are several factors which render it impossible to make accurate observations of time in studying the effects of oily solutions on the mucus-covered membrane.

First, when oil is applied to the wet mucosa it flows over the entire surface and later breaks into globules of various sizes, which distribute themselves on the face of the specimen. The distribution of the oily solution is therefore unequal, and various fields are affected in different degrees.

Second, if the entire specimen is immersed in the oil, there remains an envelop of watery solution about it for a variable time. In other words, the oil does not "wet" the membrane.

Third, the optical system has been adjusted for observing the cilia in a watery medium. In order to do this, the angle of incidence of the illumination is adjusted so that the light is reflected back into the objective. When now the oily solution is introduced between the object and the objective, light is reflected not only from the oil surface, which can be avoided by the use of an immersion cone, but from the interface between the oil and the mucoid coat which cannot. Under these con-

ditions, the cilia cannot be seen, and the observation must be interrupted until the oil has flowed away sufficiently to restore the optical system to its previous status. It is at some time during this interval that the effect of the oily solution on the cilia is produced. For this reason, the time of this effect can be recorded in minutes only approximately.

II ALCOHOL

A word of explanation should precede this report. Although alcohol is not commonly applied directly to the nose or used to an appreciable extent in any nasal medicament, it was studied for the following reason. It is not an infrequent observation that persons imbibing alcoholic drinks—not necessarily in excess—experience an excessively copious and sometimes viscous secretion of mucus from the nose and the sinuses. These phenomena may occur a few minutes to a few hours after the imbibition of the alcohol.

With the thought that this excessive secretion may serve a useful purpose in the eradication of deep-seated infections and that it may be advantageous to apply alcohol locally in weak solutions either by itself or as a vehicle for other drugs, it was included in this investigation.

The same methods being employed, it was observed that alcohol in any concentration in distilled water stops the ciliary beat in a few seconds, the rapidity depending only on the strength of the solution.

When the alcohol was diluted with Locke's solution, however, it was fairly well tolerated, for example:

A 15 per cent solution on extirpated rabbit and guinea pig mucosa caused a slight slowing after five minutes. This was not progressive, however, and the cells were still in good condition and moving actively after one hour.

An 18 per cent solution slowed the cilia at once, and after fifteen minutes practically all motility had ceased. Washing with Locke's solution, however, restored the motility, which continued for several hours, after which the experiment was stopped.

A 20 per cent solution stopped motility at once. If the mucosa is left in this solution for two or three minutes, some motility can still be restored by immersion in Locke's solution, but some areas show destruction of the surface.

A 5 per cent solution of alcohol in Locke's solution was applied in the living rabbit for over two hours without any appreciable effect.

A 10 per cent solution of alcohol in Locke's solution showed no appreciable effect when the experiments were stopped at varying intervals of over one hour.

A 20 per cent solution of alcohol in Locke's solution caused cessation of motility in twenty to thirty minutes, and the cilia could not be resuscitated by Locke's solution.

It is noteworthy that when the membranes have been bathed over short periods in the stronger solutions or for longer periods in slightly weaker ones, the interference with ciliary activity seemed to be due less to any paralyzing action on the cilia than to a disruption of the epithelium itself. There appeared numerous small, fairly parallel crevices or cracks, apparently due to coagulation and shrinkage of the surface. Between these cracks motility often continued for many minutes. The same effect was noted with ether. From this it appears that, should they prove useful, the watery solutions would be harmless in the nose, so far, at least, as ciliary action is concerned.

III WETTING AGENTS

Agents capable of reducing surface tension have recently found a multiplicity of uses in industry, particularly in augmenting and maintaining wetting, penetration and emulsification. Already they have appeared in soaps, tooth pastes and other products applicable to the human tissues. Numerous chemical agents have this characteristic in greater or less degree. Three of them were chosen for experimentation because they could be obtained in pure form and because one (the first) had already been shown to be nontoxic to rabbits in relatively large doses.

A *Decylbenzene Sodium Sulfonate*—In solutions down to 0.1 per cent this substance caused disintegration of the epithelial surface practically at once. The field became filled with cells which had become detached from the surface and swam in the surrounding medium. No ciliary motility was noted on any of these cells. Locke's solution was substituted for the distilled water with the same result. In the living rabbit, motility ceased in three minutes.

A 0.01 per cent solution of the substance in Locke's solution produced slowing of the beat in thirty minutes and entire cessation in forty-five. With the loss of motility there was also some disintegration of the membrane. In the living rabbit no change was noted after one hour.

A 0.005 per cent solution in the living animal had no demonstrable effect after indefinite periods.

B *Monobutyl Diphenyl Sodium Monosulfonate*—A 0.1 per cent solution of this substance in Locke's solution caused immediate disintegration of the tissues. A 0.01 per cent solution stopped motility in thirty-five to forty minutes. Disintegration was noted in one hour. The effects of these solutions on the living animal were as described in section A.

C *Monobutyl Phenyl Phenol Sodium Monosulfonate*—A 0.1 per cent solution of this substance in Locke's solution caused immediate dis-

integration after twenty-five minutes, which was complete in one hour. The effects of these solutions on the living animal were as described in section A.

Comment—There are numerous types of wetting agents, and it cannot be predicted from these observations what their effects will be. Experiments are now in progress to determine whether they will be available in the elimination of pathologic secretions.

IV ETHER, CHLOROFORM AND NITROGEN MONOXIDE

In the following experiments, because of clinical applicability, observations were made on the cilia of the trachea as well as the sinuses of rabbits. The method used for the second group of observations was as follows:

The animal was anesthetized with ethyl carbamate (urethane) injected intraperitoneally. This produced profound anesthesia but had no visible effect on either the vigor or the speed of the ciliary beat. The trachea was exposed through a long median incision in the neck and was freed from surrounding structures for about 2 cm. With the animal on its back, the trachea was slipped over a narrow strip of metal fastened beneath the microscope objective in place of the stage. When a small piece was removed from the front of the trachea, the interior could be readily observed through the microscope with the ultopak attachment used for sinuses. The effects of the ether and chloroform vapor and the nitrogen monoxide gas could be watched.

A Ether—In a concentrated atmosphere of ether vapor, produced by wetting a ring of cotton placed around the open trachea, the cilia performed in a normal manner over any period of time.

If a current of ether vapor was blown against the epithelium through a small tube, the beat slowed rapidly and stopped while the blast continued. Motion could be suspended for several minutes in this manner, but as soon as the vapor current no longer impinged directly on the area, resuscitation occurred within a few seconds, followed by a short interval of highly exaggerated activity. This closely resembles the results of cooling the membrane and is attributed to the cooling effect of the ether vapor and not to any specific effect on the cilia.

Warming the ether apparatus did not alter the phenomenon, but it also did not greatly increase the temperature at the point of impact, where evaporation still maintained enough cold to interfere with motility. In no experiment was there any indication that ether vapor alone caused any damage to the cilia.

In sharp contrast to this, however, was the effect produced by applying a small drop of ether directly to the membrane. In this case

activity stopped promptly and permanently, because of actual injury to the surface cells. A cracking of the surface, similar to that noted under alcohol, occurred.

B *Chloroform*—The fumes of this drug also were not found to have any demonstrable effect on the cilia in the living animal. In this case, however, two minutes' exposure of an extirpated strip of membrane to an atmosphere of chloroform vapor stopped all activity, which was only incompletely revived by washing in Locke's solution. Revival did not occur spontaneously without the washing in Locke's solution.

As in the case of ether, the chloroform itself in actual contact paralyzed the cilia at once. In this case they could be partly revived by putting them under Locke's solution within a few seconds. This revival did not persist more than ten minutes, after which there was complete immobility, apparently due to destruction of the cells.

A direct blast of chloroform vapor also stopped motility while the blast was in progress, which was likewise attributed to chilling. Recovery was immediate and motility vigorous.

C *Nitrogen Monoxide*—No application that was made in any experiment of nitrogen monoxide to the cilia or to the animal had any demonstrable effect on the ciliary motility, no matter whether the gas was concentrated or mixed with air. Animals kept under nitrogen monoxide anesthesia for twenty minutes and then killed with an overdose of the gas showed normal motility of the cilia, which were examined as quickly as it was possible to reach them after the death of the animal.

Comment—It would appear from the foregoing observations that the three anesthetics mentioned have no effect per se on ciliary activity when administered in gaseous form.

The cold produced by their evaporation may paralyze the cilia while it continues. This was especially notable with ether and chloroform, although once or twice the cold produced by releasing the gas through the valve of the cylinder had somewhat the same effect.

Actual contact of the fluid, however, is disastrous to the membrane, and it is obviously of the utmost importance to avoid accidental occurrence of such contact in the administration of anesthetics.

BLOOD CULTURES IN CASES OF OTITIC SEPSIS

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It seems fair to state that of all phlebitic infections, thrombosis of the lateral sinus presents the most constant features. In no other disease is one particular venous channel so regularly and consistently involved. For this reason the bacteremia which is always associated with thrombosis of the lateral sinus becomes the most important clinical finding of the disease. The recognition of the bacteremia is of paramount importance in the diagnosis of the condition and is of value in interpreting especially the course and the prognosis of the illness. In view of this, the significance of interpretation of blood cultures in cases of thrombosis of the lateral sinus deserves special consideration.

Of the great contributions to otology, Libman's¹ original work on thrombosis of the lateral sinus occupies an eminent position. Further investigations on the subject have corroborated his observation that bacteremia can be demonstrated often in this disease and that the invading micro-organism is usually *Streptococcus haemolyticus* (beta-Brown).

The infected thrombus, which may either be attached to the wall or occlude the lumen, constantly releases thrombotic particles infected with micro-organisms into the blood stream, which is responsible for the characteristic clinical picture of chills and septic fever. Thus it is reasonable to conclude that thrombosis of the lateral sinus is always associated with bacteremia at some time during the course of the disease, especially in the early stages of the formation of the thrombus. As bacteremia is the only uncontradictable direct evidence that the condition offers, the diagnostic importance of blood culture becomes obvious.

From the Departments of Otology and Laryngology and the Laboratories of the Mount Sinai Hospital.

1 Libman, E., in discussion on Gruening, E. Six Cases of Thrombosis of the Lateral Sinus Operated upon in the Ear Ward of the Mount Sinai Hospital in the Course of the Past Winter, *Tr. Am. Otol. Soc.* **10** 304, 1906, A Further Communication on the Importance of Blood Cultures in the Study of Infections of Otic Origin, *Transactions of the Ninth International Otological Congress*, Boston, 1912, p. 127.

BACTERIOLOGIC PICTURE

The micro-organism isolated from the infected blood stream in cases of thrombosis of the lateral sinus is usually *Str haemolyticus* and rarely *Pneumococcus* type III or some other micro-organism. In twelve years inclusive of 1937, 104 cases of thrombosis of the lateral sinus including primary thrombosis of the jugular bulb were observed at the Mount Sinai Hospital.² In 2 instances the diagnosis was made at necropsy, and operations were performed in the remaining 102 cases. Of the 104 cases no preoperative blood culture was taken in 4, the preoperative blood culture was sterile in 8, and a positive preoperative blood culture was obtained in the remaining 92. Thus the preoperative blood culture was positive in 92 per cent of the cases in which it was taken. The

TABLE 1—*Bacteriologic Picture of Blood Cultures in Cases of Thrombosis of the Lateral Sinus Observed in Twelve Years*

Total cases	104
Patients operated on	102
Diagnosis made post mortem	2
No cultures taken	4
Preoperative cultures sterile	8
<i>Str haemolyticus</i>	88
<i>B proteus</i>	2
<i>B pyocyaneus</i>	1
<i>Pneumococcus</i> type III	1
Per cent of preoperative blood cultures positive	92
Per cent of positive cultures yielding <i>Str haemolyticus</i>	95.7

micro-organism isolated in the 92 positive preoperative blood cultures was *Str haemolyticus* in 88 cases, *Bacillus proteus* in 2 cases, *Bacillus pyocyaneus* in 1 case and *Pneumococcus* type III in 1 case. *Str haemolyticus*, therefore, was obtained in 95.7 per cent of the cases of proved bacteremia (table 1).

Although the hemolytic streptococcus is also the predominant etiologic micro-organism in acute mastoiditis, *Streptococcus viridans* (alpha-Brown), *Streptococcus* of the nonhemolytic type (gamma-Brown), *Staphylococcus aureus* and *albus* and various types of *Pneumococcus* have been isolated from infected mastoid bones. Infection of the lateral sinus developed in about 7 to 8 per cent of the cases of mastoiditis due to *Str haemolyticus* which were observed at the hospital during the twelve

2 From the service of Dr. I. Friesner.

years under consideration (In a large number of these cases the patient was admitted to the hospital with the clinical picture of otitic sepsis) Of 83 cases of mastoiditis due to *Pneumococcus* type III, thrombosis of the lateral sinus developed in 1 It appears from these considerations that *Str. haemolyticus* possesses in certain cases of acute mastoiditis a predilection for the lateral sinus

Rarely such a micro-organism as *B. proteus* or *B. pyocyaneus* may become pathogenic and lead to infection of the mastoid bone and also of the lateral sinus When this occurs, the infection is usually an acute exacerbation of chronic suppuration of the middle ear Infection with each of these micro-organisms resulted in a fatal issue and happened to occur in children

The success with which bacteremia is demonstrated is largely dependent on the method of blood culture employed As the number of micro-organisms which circulate in the blood stream is often scant and as there is a natural mortality among micro-organisms in blood culture mediums, certain principles for the maintenance and enhancement of bacterial growth should be observed to obtain good results In any technic of blood culture the features necessary to obtain a high percentage of positive cultures are the inoculation of a large quantity of blood, the use of various and rich mediums, daily spreads, subcultures and prolonged observation The technic of blood culture employed at the Mount Sinai Hospital is described in complete detail elsewhere³

Every once in a while a strictly anaerobic type of *Str. haemolyticus* is responsible for phlebitis of the lateral sinus It is necessary, of course, to use suitable anaerobic mediums to recover and grow this micro-organism from drawn blood At the present time an anaerobic medium is employed routinely in the blood cultures at the Mount Sinai Hospital

INTERPRETATION OF BLOOD CULTURES

In the interpretation of the blood cultures, much attention should be paid to the fluid mediums Often the micro-organisms, especially *Str. haemolyticus*, grow only in fluid mediums and not on solid mediums To obtain growth in a suitable fluid medium, inoculation with only a small number of micro-organisms is necessary They will multiply until the maximum concentration of micro-organisms for the medium is reached On a solid medium, one micro-organism will yield only one colony When it is realized that the initial mortality of bacteria on solid mediums is considerably greater than in fluid mediums, the value of the fluid medium in culturing micro-organisms can be readily appre-

3 Shwartzman, G, and Goldman, J L *Streptococcus Hemolyticus Bacteremia A Study of One Hundred and Sixty-Eight Cases*, Arch Surg **34** 82 (Jan) 1937

ciated The analysis of preoperative positive blood cultures in the cases which we have studied shows that growth was obtained in fluid mediums alone in 48.4 per cent of the cultures Of special importance is the fact that the micro-organism was isolated from only one flask in 22.7 per cent of the preoperative positive blood cultures When growth is obtained in one fluid medium, it is not infrequently in the most luxuriant medium (table 2)

It is now pertinent to consider the significance of the number of micro-organisms found in blood cultures and accordingly the number present in the blood stream When the micro-organisms circulating in the blood stream are few they are more difficult to grow on blood culture Thus the growth in fluid mediums alone especially in one fluid medium and not on solid mediums indicates a paucity of micro-organisms in the circulation From a purely diagnostic point of view however the number of micro-organisms in the blood stream in thrombosis

TABLE 2—*Analysis of Mediums of Blood Cultures in Cases of Thrombosis of the Lateral Sinus Observed in Twelve Years*

	One Medium*	Two Mediums†	Three Mediums‡	All Mediums	Mixed Fluid and Solid	Total
Preoperative	23	5	18	49	3	101
Postoperative	3	6	11	20	0	49

* Usually tomato or dextrose broth

† Usually tomato and dextrose broth

‡ Tomato, dextrose and plain broth.

of the lateral sinus is of little significance When one is dealing with *Str. haemolyticus* the presence of even a few micro-organisms in the blood stream or the growth of the micro-organism in only one flask indicates definitely the existence of infection The solid mediums are of value largely in the quantitative determination of the concentration of the micro-organisms in the blood stream Thus in a case of suspected thrombosis of the lateral sinus growth of *Str. haemolyticus* in fluid mediums only even in a single flask on one occasion is suggestive of infection of the wall of the sinus after all other clinical possibilities have been reasonably considered and excluded The presence of *Str. haemolyticus* in one flask of fluid medium has the same import in establishment of the diagnosis as discovering growth in all the mediums Accordingly under these circumstances such a finding also is an indication for operative intervention

CLINICAL VALUE OF BLOOD CULTURES

Since these facts concerning thrombosis of the lateral sinus have been fully appreciated studies of blood cultures have been especially helpful

in diagnosing septicemia when a vague otitic history is given and the physical findings are inconclusive. The discovery of *Str. haemolyticus* in such cases has led to the diagnosis of thrombosis of the lateral sinus with consistent accuracy, after all other sources of infection have been logically excluded. Conspicuously illustrative of such instances is the type of sinus thrombosis known as primary thrombosis of the jugular bulb.⁴ The patients when examined usually present a healed or healing infection of the middle ear and no evidence of mastoiditis. The history of a recent otitic infection and the presence of septicemia suggest the possibility of a primary thrombosis of the jugular bulb, but the finding of infection of the blood stream with a hemolytic streptococcus establishes the diagnosis when no other focus of infection can be ascertained clinically.

Blood cultures can play an important role in the differential diagnosis of conditions which present the clinical picture of sepsis in association with otitic infections. First of all, in my experience infections of the middle ear and mastoid bone are not associated with bacteremia. An otitic infection with a positive blood culture, especially of *Str. haemolyticus*, strongly suggests the existence of thrombosis of the lateral sinus or primary thrombosis of the jugular bulb, after all other conditions producing a state of sepsis have been reasonably excluded.

The complication which is likely to confuse the clinical picture of otitic infection is erysipelas. Erysipelas in its earlier stages may produce bacteremia, and the micro-organism always isolated from the blood stream is *Str. haemolyticus*. The confusing feature of the disease is the fact that the bacteremia may exist during the first day or two of the illness, before the erythematous lesion appears. This has been particularly noted in children. Pharyngeal and nasopharyngeal infections also may cause *Str. haemolyticus* to appear in the blood stream, but the portal of entry in these instances may be difficult or impossible to discover. When *Str. haemolyticus* appears in the blood stream because of meningeal or pneumonic infections, the condition as a rule is readily differentiated and diagnosed by evident manifestations and findings relative to the particular organ involved.

A valuable aid in determining the portal of entry of bacteremia when infection from another source is possible in addition to otitic infection is the differential blood culture described by Ottenberg.⁵ The number of micro-organisms in the blood drawn from each internal jugular vein and cultured on blood plates is compared with the number in the blood

4 Maybaum, J. L., and Goldman, J. L. Primary Jugular Bulb Thrombosis, *Arch. Otolaryng.* **17** 70 (Jan.) 1933.

5 Ottenberg, R. Differential Blood Cultures, *J. A. M. A.* **94** 1896 (June 14) 1930.

obtained from a peripheral vein. In cases of thrombosis of the lateral sinus the differential blood culture has shown an appreciably larger number of micro-organisms in the blood drawn from either or both internal jugular veins than in that drawn from the peripheral vein, while in cases of infection not in the head but, for example, in the heart, the kidney or the bone of a limb, the number of micro-organisms was the same in the blood obtained from each jugular vein and from the peripheral vein. Thus, such blood cultures can be helpful in the differential diagnosis of bacteremia resulting from infections of the head and that resulting from infections of the body or limbs.

In cases of bilateral otitic infection associated with bacteremia, the differential blood culture is not a reliable method to determine the side on which the phlebitis exists. Ottenberg showed that in one-half the cases of thrombosis of the lateral sinus with bacteremia the preponderating number of micro-organisms was found, not in the blood from the internal jugular vein on the same side as the thrombosed lateral sinus, but in the blood from the internal jugular vein draining the opposite, or normal, sinus. The most probable explanation for this finding is that in these instances micro-organisms were growing chiefly at the upper end of the thrombus and entered the circulation by way of anastomosis to the opposite, unobstructed, jugular vein. The circulation at the proximal end of the jugular vein and the bulb on the diseased side is far less active than at the end near the torcular Herophili. In every one of the cases in which the preponderating number of micro-organisms was found in the blood obtained from the normal side, an obliterating thrombus was discovered in the diseased sinus at operation. In cases of sinus phlebitis without complete obstruction to the blood current in the sinus, Ottenberg found the larger number of micro-organisms consistently in the blood from the homolateral jugular vein.

It appears after a review of the literature and from my experience that only the type III pneumococcus of all the pneumococci produces phlebitis of the lateral sinus. Even this occurrence is comparatively rare. Thus, blood culture is of inestimable value in the differential diagnosis of pneumonic infections associated with otitic infections. The finding in the blood stream of a pneumococcus other than type III in the presence of a septic picture and otitic infection should make one suspect the existence of pneumonic infection.

On two occasions I have observed infection of the blood stream with *Str. haemolyticus* complicating mastoiditis due to *Pneumococcus* type III. The blood cultures were taken because of the development of a septic clinical picture. Both patients had erysipelas. In one instance the erythematous lesion appeared after the blood culture was reported, and in the other there was a suggestive lesion when the blood was drawn for culture.

Repeated sterile cultures represent information which should be seriously considered in the evaluation of conditions under observation.^{5a} An otologist who has reliable bacteriologic studies at his disposal should be disinclined to operate for a suspected sinus thrombosis when repeated cultures of the blood are sterile, unless undeniable clinical findings are encountered. This policy has borne satisfactory results, for such conditions after a period of observation have evidenced manifestations which indicated the presence of pneumonia, pharyngeal infection, pyelonephritis, meningitis or some other illness which accounted for the clinical course.

Blood cultures are helpful also in the postoperative management of thrombosis of the lateral sinus. Repeated growth of the micro-organism in cultures after operation suggests that the venous infection has not been entirely obliterated or blocked off and usually indicates that further operative intervention is required. It may be necessary to obliterate more of the end of the lateral sinus near the torcular Herophili or to evacuate an abscess in the jugular bulb. Of course, at times, when the petrosal sinuses and other channels are involved, the phlebitis is beyond surgical approach. In this connection it should be mentioned that a metastatic osteomyelitic focus may also be the source of a persistent bacteremia. Metastases to the various soft parts of the body and articular structures do not seem to give rise to secondary invasion of the blood stream.

It is appropriate at this point to discuss the meanings of descriptive terms usually associated with bacteremia, particularly because of the significance of proper interpretation of *Str. haemolyticus* in the blood stream. The importance for clarification of such terms has been emphasized by Friesner.⁶ Often invasion of the blood stream is described as "transient" bacteremia. This implies that the bacteria, after they gain entry into the blood stream, remain there for a short time only and that the bacterial invasion into the general circulation does not recur. Should, however, the release of bacteria into the blood stream occur repeatedly, the bacteremia is considered persistent.

5a The significance of sterile blood cultures must be modified in cases in which sulfanilamide has been administered. It has become an accepted observation that sulfanilamide can be responsible for sterile blood cultures in cases of *Str. hemolyticus* bacteremia. Thus, it is important to emphasize that sulfanilamide may mask the clinical picture so that the diagnosis of thrombosis of the lateral sinus cannot be made. I believe that sulfanilamide should not be administered until after the diagnosis has been definitely established. (Maybaum, J. L., Snyder, E. R., and Coleman, L. L. The Value of Sulfanilamide in Otogenous Infections with Special Reference to Its Masking Effect, *J. A. M. A.* **112** 2589 [June 24] 1939.)

6 Friesner, I. Infections of the Middle Ear. Acute Systemic Infections from the Ear, *Arch. Otolaryng.* **14** 257 (Sept.) 1931.

From the diagnostic and the prognostic point of view, it is necessary to establish the clinical importance of bacteremia. For instance, studies on human beings⁷ and animals⁸ have shown that transient invasion of the blood stream by *Str viridans* may occur without any demonstrable suppurative focus and be clinically unimportant so far as any direct relation to the illness or subject is concerned. In human beings this micro-organism has been isolated from the general circulation in the presence of different debilitating conditions and in animals after the ingestion of fatty meals. In a condition such as subacute bacterial endocarditis,⁹ *Str viridans* is found repeatedly in blood cultures, and accordingly the persistent bacteremia becomes a finding of clinical importance.

Experience has demonstrated also that other micro-organisms, especially *Staphylococcus albus*, *Streptococcus nonhaemolyticus* and *Bacillus coli*, may be discovered in the blood on an occasion without clinical significance. Thus, transient bacteremia from which the micro-organisms mentioned can be obtained may be clinically unimportant and have no diagnostic or prognostic value. It is usually necessary that persistent presence of these micro-organisms in the blood stream be demonstrated before clinical significance can be ascribed to the invasion.

Transient infection of the blood stream with *Str haemolyticus*, on the other hand, is always of clinical significance and importance. It indicates the existence of phlebitis secondary to a contiguous inflammatory process or massive invasion of the circulation by the micro-organisms resulting from surgical or traumatic manipulation of an infected area. In a study of 168 cases of *Str haemolyticus* in the blood stream, Schwartzman and I³ were able to find a focus of infection in every instance. In cases of thrombosis of the lateral sinus, nasopharyngeal or pharyngeal infection and erysipelas, it is not uncommon to find *Str haemolyticus* in the blood stream on one occasion, but such a discovery should be regarded as information of great import.

Thus, the significance of transient bacteremia is dependent on the micro-organism circulating in the blood on the particular occasion. In some instances the bacteremia must be persistent before it can be considered significant. It seems to me that the term "transient" bacteremia should always be qualified to denote whether the condition is clinically significant or insignificant, and I consider a term such as "frank" bacteremia uninformative.

7 Lichtman, S. S., and Gross, L. Streptococci in the Blood in Rheumatic Fever, Rheumatoid Arthritis and Other Diseases, *Arch Int Med* **49** 1078 (June) 1932.

8 Desoubry, M. G., and Porcher, M. C. De la presence de microbes dans le chyle normal chez le chien, *Compt rend Soc de biol* **47** 101, 1895.

9 Libman, E. Characterization of Various Forms of Endocarditis, *J. A. M. A* **80** 813 (March 24) 1923.

CONCLUSION

The early diagnosis of thrombosis of the lateral sinus or primary thrombosis of the jugular bulb, before the manifest and evident clinical picture has appeared, and the consequent early operation will contribute greatly to diminish the morbidity, the metastases and the mortality from the disease. It is my opinion that adequate and complete studies of the blood culture with their proper interpretation will help to achieve this end to a gratifying degree.

SUMMARY

Bacteremia is the most constant clinical feature in cases of thrombosis of the lateral sinus. Accordingly, recognition of the bacteremia is an important finding for the diagnosis and clinical management of otitic sepsis.

The micro-organism usually isolated from the blood stream in cases of thrombosis of the lateral sinus is *Str. haemolyticus*. It was recovered from 95.7 per cent of cases of proved bacteremia associated with otitic sepsis. It appears from bacteriologic investigations that thrombosis of the lateral sinus, with rare exceptions, is essentially a disease caused by *Str. haemolyticus*.

The demonstration of invasion of the blood stream is dependent on the methods used in taking and cultivating the blood. In the interpretation of blood cultures special attention should be directed to the consideration of the number of micro-organisms cultured, and importance should be attached to the growth of micro-organisms in fluid mediums alone. Analysis of the preoperative blood cultures in this series showed that *Str. haemolyticus* was obtained from the fluid mediums alone in 48.4 per cent of the cultures and from one fluid medium in 22.7 per cent of the cultures. It is my opinion that finding *Str. haemolyticus* in a case of suspected otitic sepsis, even in small numbers and in fluid mediums alone, establishes the diagnosis of thrombosis of lateral sinus or primary thrombosis of the jugular bulb after all other clinical possibilities have been excluded. With this concept in mind, blood cultures should contribute greatly to the diagnosis of septicemia when there is a vague otitic history with inconclusive physical evidence.

Proper interpretation of blood culture can be helpful also in the management of proved otitic sepsis and in the differential diagnosis of conditions simulating otitic sepsis. In cases of clinical sepsis associated with infections of the middle ear, sterile blood cultures also give information of great value. In this connection it is important to emphasize that in my experience infections confined to the middle ear and mastoid bone have not been associated with bacteremia.

It seems pertinent in the discussion of invasion of the blood stream that clinically significant bacteremia should be differentiated from clinically insignificant bacteremia and described as such.

HAY FEVER AMONG JAPANESE

III STUDIES OF ATMOSPHERIC POLLEN IN TOKYO AND IN KOBE

H J HARA, M D, P H D, D Sc (Med)

LOS ANGELES

On the eastern coast of Asia is a festoon-like group of islands, extending from the tip of Kamchatka on the north obliquely down toward the equator to almost within reach of the peninsula of Malacca on the south, a distance of nearly 2,500 miles (4,000 kilometers). These islands compose Japan proper. They are between 77 and 200 miles (124 and 322 kilometers) wide, and the census of 1935 gave their population as 74,000,000. The area is not larger than that of the state of California, but so extensive is the archipelago north and south that there are subarctic, temperate, semitropical and tropical temperatures.

It is well known that the people in this area have always been free from hay fever, although other forms of allergic disorder, such as bronchial asthma, migraine, urticaria and atopic dermatoses, are as prevalent as in other parts of the world. Missionaries, business men and tourists from America and Europe enjoy equal immunity from hay fever while there. Hawaiian and Californian Japanese who have been perennial sufferers from allergic rhinitis find complete relief as long as they remain in Japan. On their return to Hawaii or America, they invariably experience a recurrence of hay fever after the lapse of a year or two.

PATHOGENIC FACTORS

There are three factors of prime importance in the development of hay fever. They are (1) allergic constitutional predisposition, (2) potent antigenic pollens and (3) the meteorologic condition of the region.

The fundamental principle is shown in figure 1. The factors are interdependent. Absence of any one of the three results in immunity from hay fever.

There is abundant evidence to show that the Japanese possess no racial immunity to allergic disorders. In a survey¹ previously conducted it was revealed that 3.5 per cent of the Japanese population in Southern California showed clinical signs of hay fever.

It is now indisputably established that pollen is the exciting cause of hay fever. The types and quantity of pollen in the air and the

From the Department of Otolaryngology, College of Medical Evangelists

¹ Hara, H J. Hay Fever Among Japanese. I. Arch Otolaryng 20: 668-676 (Nov.) 1934

distribution of the vegetation that produces it are principally governed by the combination of edaphic, climatic and topographic factors. Meteorologic conditions, such as temperature, precipitation, humidity, motion of air, amount of sunshine and proximity to a large body of water, are factors of importance. Besides having a peculiar inherited constitution, called atopy, the allergic person must be exposed to pollen in sufficient quantity and for an adequate time. It is after ten to fifteen years of residence in California that men born in Japan first acquire hay fever. Among women the average duration of exposure before the subjective symptoms appear is five years.

WEATHER

In a later study I dealt at length with the weather in Japan. Briefly, the summer in Tokyo and Kobe, Japan, is short, hot and humid, not unlike that of the midwestern cities of the United States or those on the

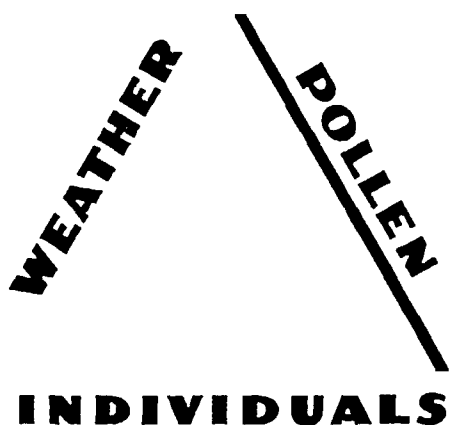


Fig. 1—Factors in the development of hay fever

Atlantic seaboard, with numerous thunderstorms followed by heavy rains. During July, August and September the daily temperatures of these two cities fluctuate between 70 and 80 F., and this is about 10 degrees higher than the temperature of Los Angeles. The relative humidity of Los Angeles is seldom above 65 per cent. In both Tokyo and Kobe the moisture content of the air gradually rises during the spring, until it reaches its peak in July and August. In September the humidity begins to decrease to the perennial level. The annual average humidity in Tokyo is 72 per cent, in Kobe 75 per cent, in New York 73 per cent and in Chicago 77 per cent.

Precipitation—Japan is a wet country. The average annual rainfall is 40 inches (1 meter). In Los Angeles it is 10 inches (25 cm.), in New York, 15 inches (38 cm.), in Chicago, 18 inches (46 cm.)

² Hara, H. J. Hay Fever Among Japanese. II, Arch. Otolaryng. **21** 9-26 (Jan.) 1935

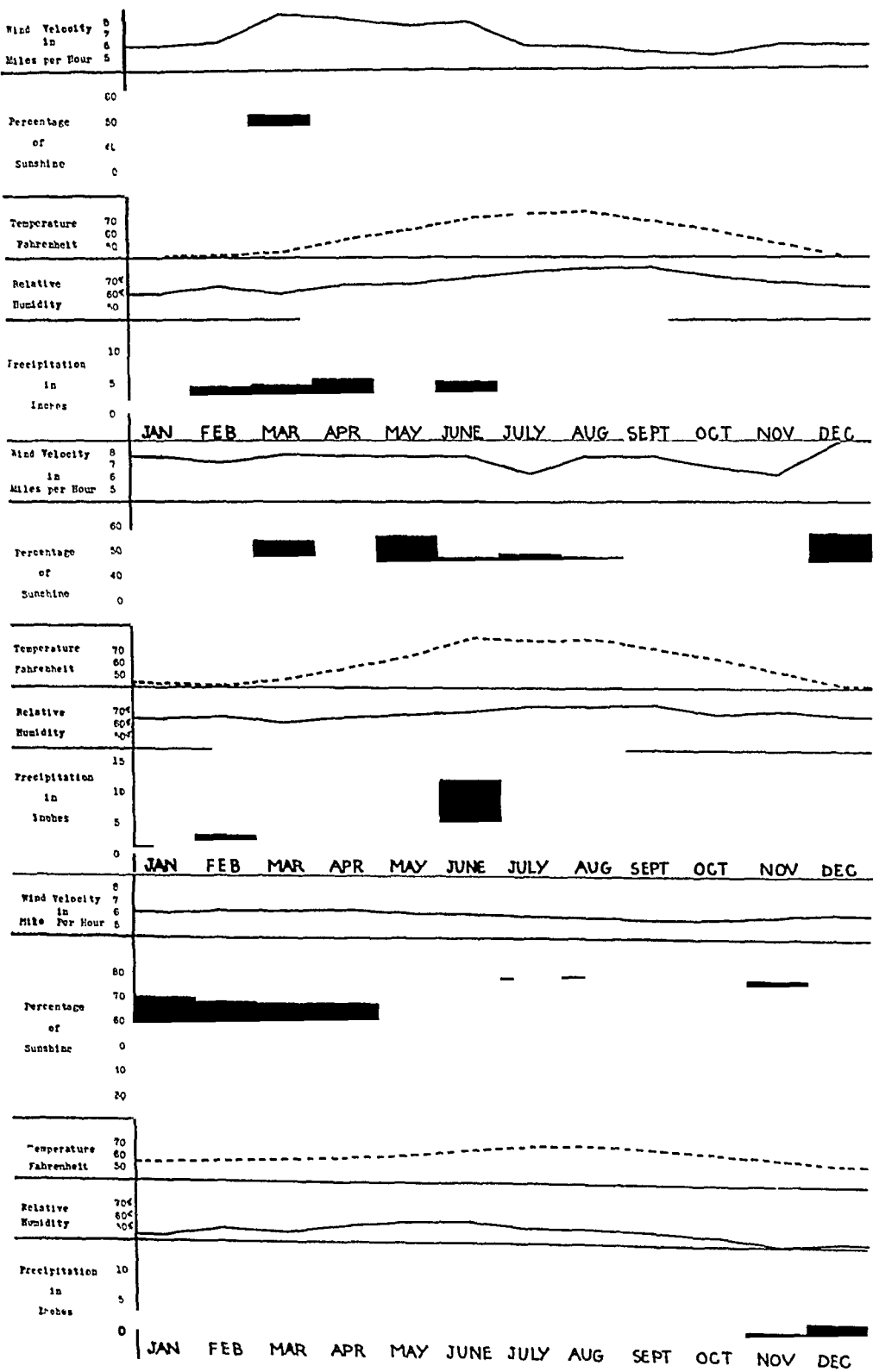


Fig 2—Meteorograms for Tokyo (above), Kobe (middle) and Los Angeles (below)

There are three wet seasons in Tokyo (1) from the middle of April to the beginning of May, (2) from the middle of June to the beginning of July, and (3) the heaviest, from the latter part of August to the middle of October. January is the driest and September the wettest month in Tokyo. During the four months from November to February only about 18 per cent of the year's total amount of rain falls, and thus the greater portion of the annual precipitation falls in the months when pollination is most active. Kobe has almost the same periods of precipitation. Doubtless this is an important factor in keeping the atmosphere of the island free from dust and pollen. The snowfall is insignificant in the two cities mentioned, seldom attaining a depth of more than 4 or 5 inches (10 or 13 cm) and melting in a few days. On the average there are about four sunny days for every three days of rain, or a total of two hundred and fifteen days of sunshine and one hundred and fifty days of rain or snow.

Direction and Speed of Wind—Two opposing ocean currents bathe the shores of the islands. One is known as the Japan current, and the other is the Kurile stream. The first is warm, and the second is cold. During the winter the winds come from Siberia, often they acquire considerable velocity, and it is icy cold. During the spring and summer the winds are reversed. Influenced by the Japan current, the air is balmy, and the breeze is light, during the summer, however, the air is sultry and at times unbearably humid. Figure 2 presents meteorograms of Tokyo, Kobe and Los Angeles.

POLLEN ENUMERATION

The absence of hay fever in Japan prompted me to investigate the pollen contents of the air in Sapporo, Japan, in 1934. This is one of the largest cities, located on the island of Hokkaido in the extreme northern part of the empire. Because of its situation, the winter in Sapporo is long and extremely cold, the temperature going as low as 10 degrees (F) below freezing and remaining there for weeks. The summer is short and mild. Thus the pollinating period in Sapporo is comparatively short.

The present investigation deals with the pollen content of the atmosphere of Tokyo and Kobe. Both these cities are located on the main island, considerably south of Sapporo, and facing the Pacific Ocean. Tokyo has been the capital of Japan for the past seventy years, and its population, according to the census of 1938, is 6,963,900. Kobe has a population of 980,000 and is noted for its industries and foreign trade.

The city is built on the hillside on the shore of the inland sea. These two cities were chosen because their climatic conditions appear to be fairly representative of the island.

During 1936, through the cooperation of my brother, Dr. Saburo Hara, a practicing physician in Kobe, I was able to obtain a series of glass slides which had been exposed to the air of Tokyo and Kobe from March to November. The slides measured 1 by 3 inches (2.5 by 7.6 cm). They were covered with a thin coat of petrolatum and exposed for each twenty-four hours, about 100 feet (30 meters) above sea level, in the corner of a garden. At the end of the twenty-four hours each was collected, dated and packed in a dust-proof box, later the slides were shipped to me for study of the pollen. On reaching America they were thoroughly examined by assistants in my office to determine the

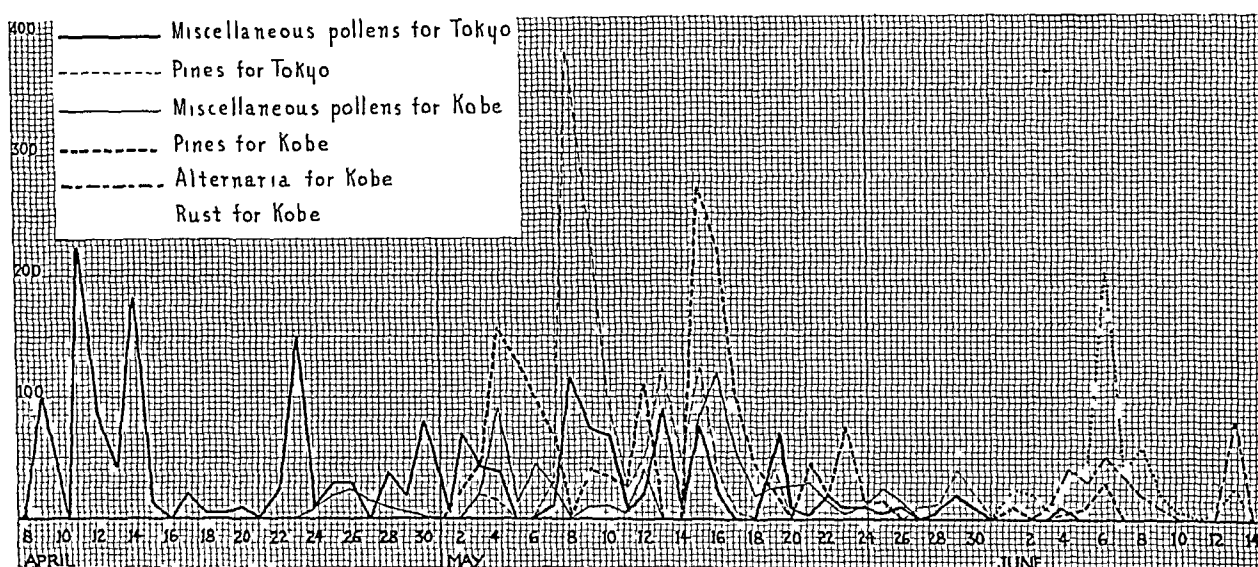


Fig. 3—Pollen enumeration for Tokyo and Kobe

nature and character of pollens and fungi encountered on them. They were also submitted to M. O. C. Durham, the chief botanist of the Abbott Laboratories, Chicago, for his verification. Unfortunately a number of slides from Kobe were destroyed during the transit from Los Angeles to Chicago, but a sufficient number were left unharmed.

Figure 3 indicates the names and numbers of the pollens on the slides from Tokyo and Kobe. It will be noted that the pollinating season on the main island begins in March. By far the most numerous of the pollens encountered were those of various species of pine, which are abundant all over the island. The pollen of pines has been known to be nonantigenic or only feebly antigenic and to play little or no part in the causation of hay fever. The miscellaneous pollens are not numerically significant. In recent years the importance of fungi in

causing allergic rhinitis has been increasingly recognized by various workers. The number of fungi present is also tabulated.

Comparative Toxicity of Pollens—In order to test the comparative allergenic potency of Japanese pollens, about 30 Gm each of the pollens of corn (*Zea mays*) (fig 4), lamb's-quarters (*Chenopodium album*) (fig 5), common plantain (*Plantago major*) (fig 6) and sheep's sorrel (*Rumex acetosella*) (fig 7) were obtained through the courtesy of Professor K. Koiba, head of the department of botany of the Imperial University of Kyoto, Japan. (The Japanese pollen was much dehydrated, and photographs are somewhat distorted.) The pollen of the corresponding California plants is shown below the Japanese pollen. Among those not shown in the photomicrographs were specimens of the pollens of orchard grass (*Dactylis glomerata*) and hog millet (*Panicum miliaceum*) sent by Prof. Dr. H. Kosakabe, the professor and head of the department of otolaryngology at the Hokkaido Imperial University. Unfortunately these pollens were damaged during transit and could not be used for this study. Each of the pollens from Kyoto was treated with alcohol and glycerin for extraction according to the usual technic of Coca. The pollens of the corresponding six plants of California were treated in similar manner and the exciting principles obtained. This work was done at the Loma Linda Laboratory of Allergy, College of Medical Evangelists, Loma Linda, Calif., under the direct supervision of Dr. Alfred Roos, the allergist in charge. In the course of examination of patients for allergy, when a positive reaction was obtained to an extract of the California pollen another test was immediately made beside it with the Japanese pollen of the same plant in order to compare its potency. This work was done during the season of 1937 and 1938. Only a limited number of patients were so tested, but the results were sufficient to cause me to believe that there is no difference in the local reaction, for even the shape and size of the pseudopods were the same.

Reasons for Absence of Hay Fever in Japan—Botanic surveys indicate that some plants outstanding among the causes of hay fever in Southern California, such as Bermuda grass (*Cyniopsis dactylon*) are absent in Japan. Ragweed though unknown up to recent years, is said to be coming into the country, but it is certainly a much less important factor in Japan than in California. However, there are almost equally important plants, such as cultivated and wild oats (*Avena sativa* and *Avena fatua*), cultivated barley (*Hordeum vulgare*), cultivated wheat (*Triticum vulgare*), annual blue grass (*Poa annua*), lamb's-quarters (*Chenopodium album*) and sweet vernal grass (*Anthoxanthum odoratum*).

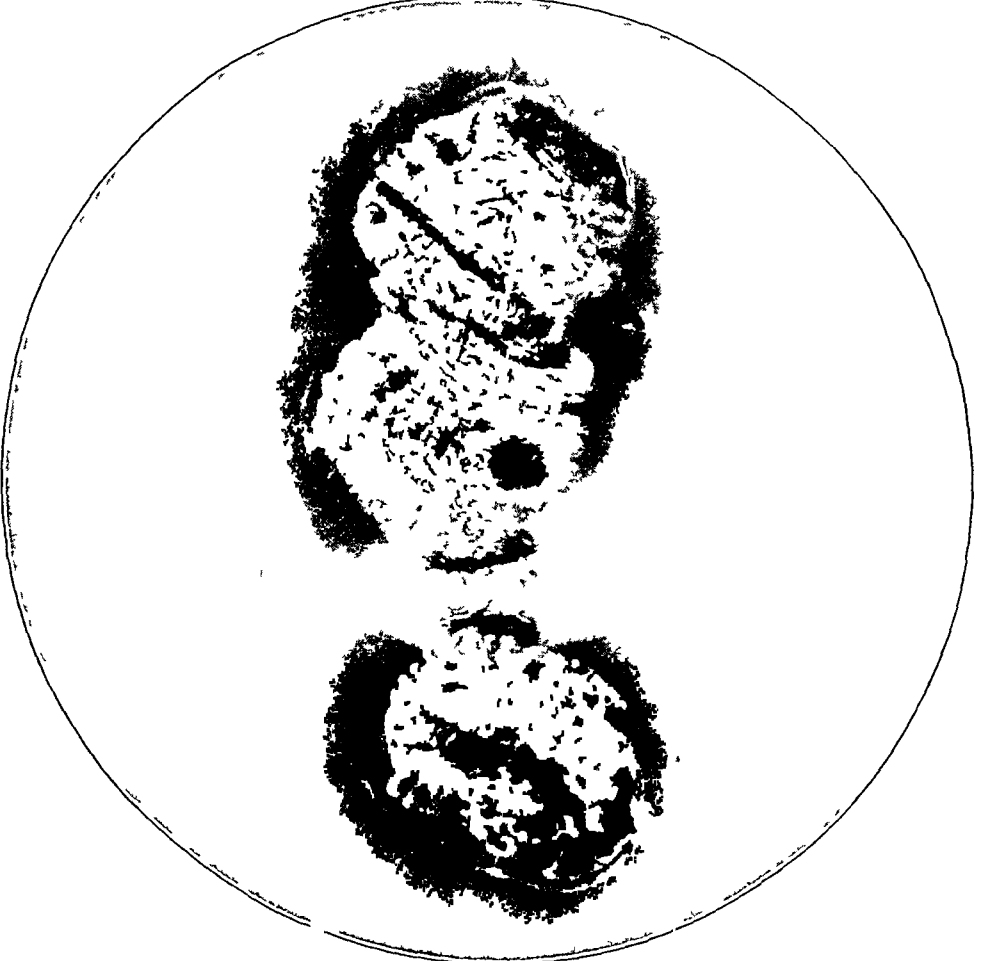
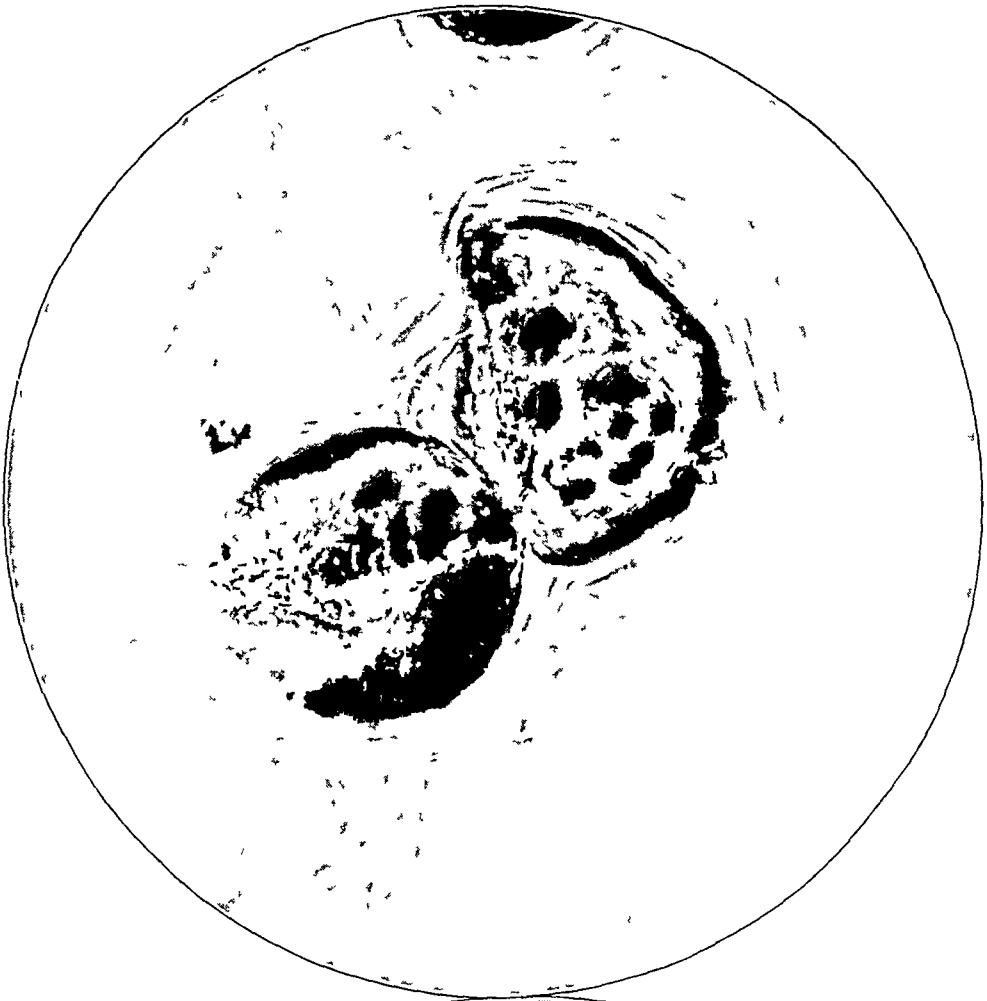


Fig 4—Japanese (above) and California corn (*Zea mays*) , $\times 360$

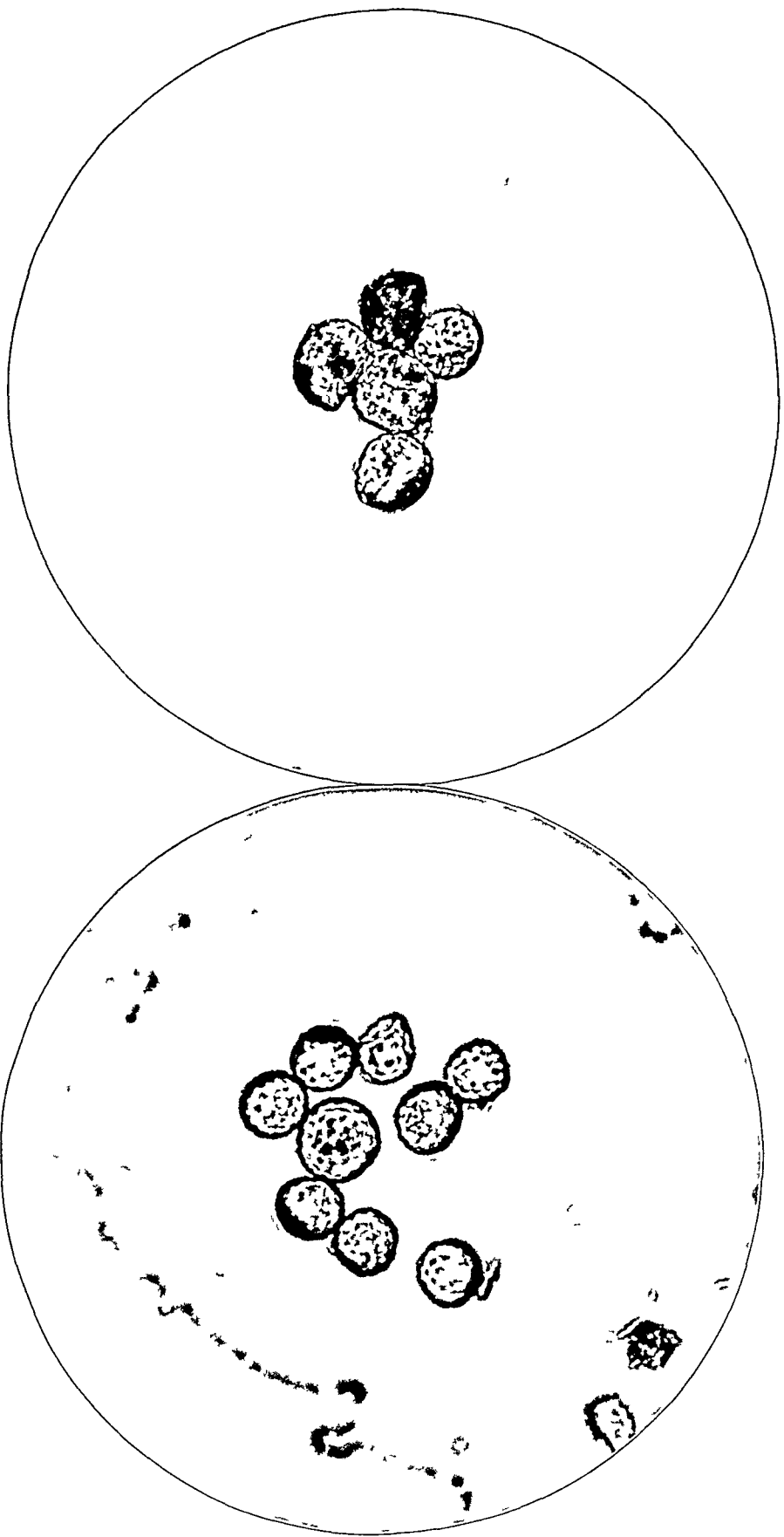


Fig 5—Japanese (above) and California lamb's-quarters (*Chenopodium album*), $\times 360$

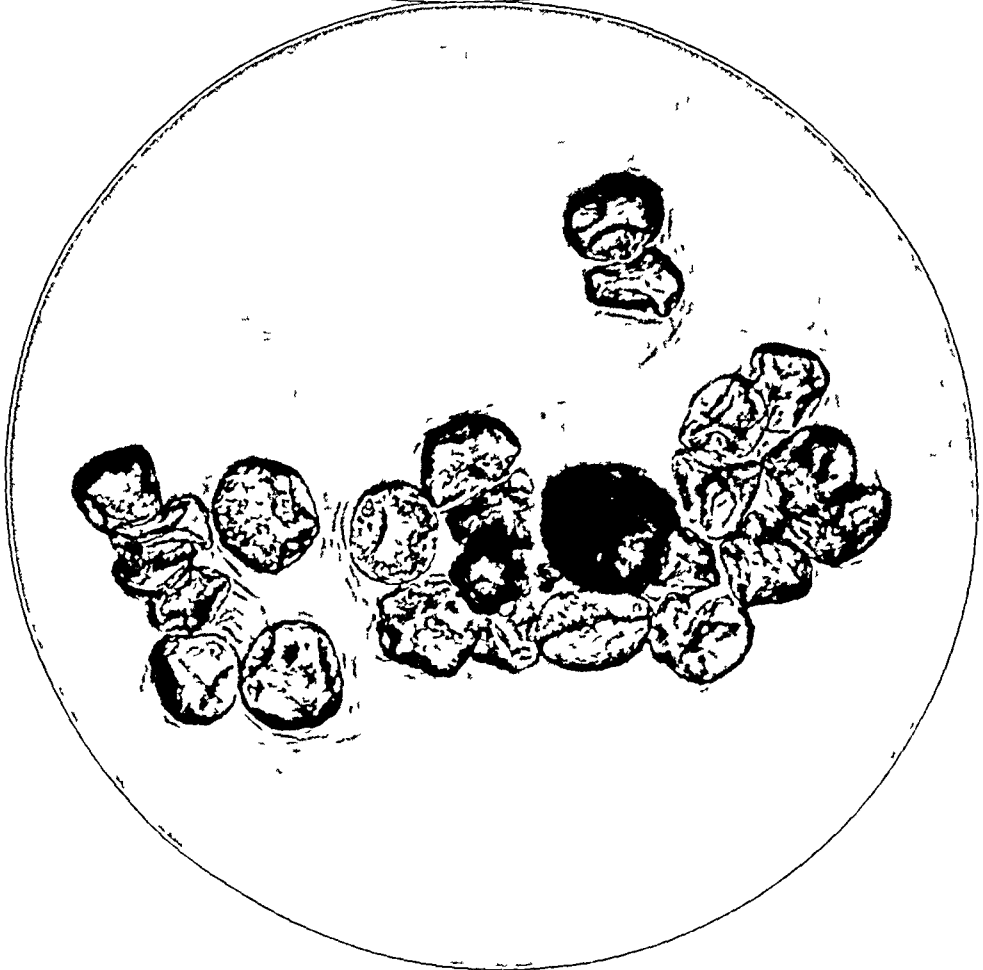
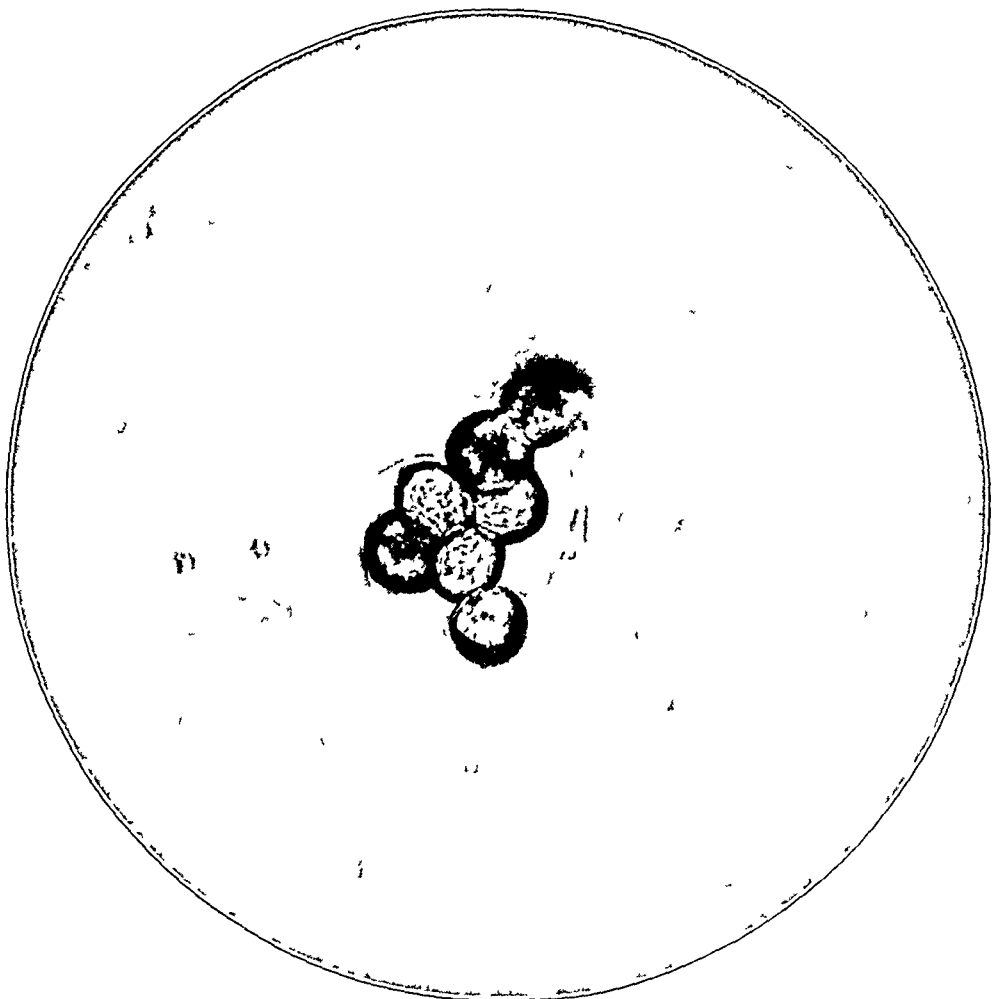


Fig 6—Japanese (above) and California common plantain (*Plantago major*),
 × 360

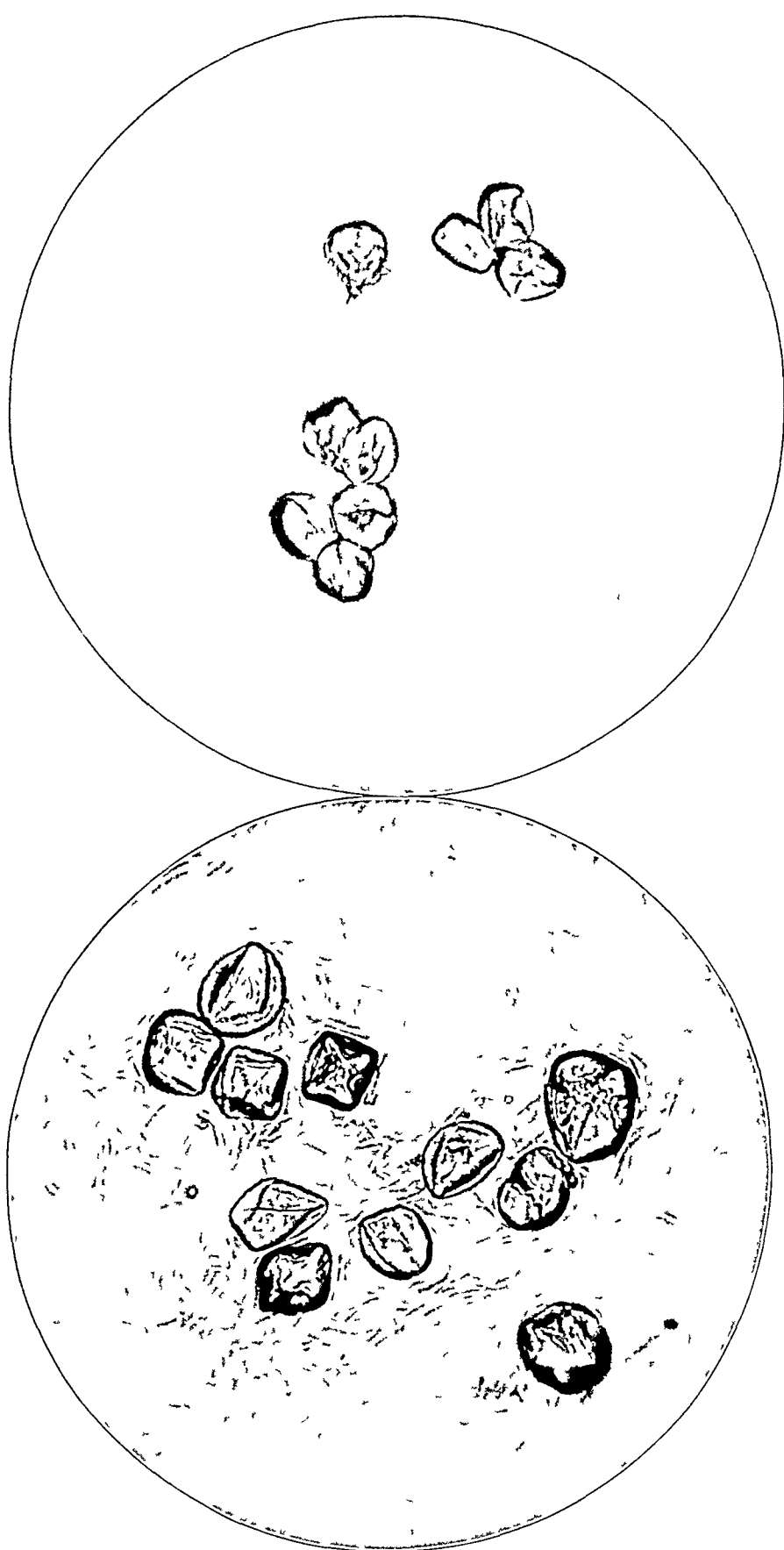


FIG 7—Japanese (above) and California sheep sorrel (*Rumex acetosella*),
× 360

According to a statement in the *Japan Times*' year book of 1938, the flora of Japan consists of about 17,087 species, classified as follows

Flowering plants	9,000
Ferns	700
Mosses	2,000
Fungi	3,500
Lichens	700
Marine algae	691
Freshwater algae	323
Mycetozoa	173

Favored by rich soil, high temperature and abundant rainfall well distributed, through the year, the Japanese islands boast of an unusually luxuriant growth of plants and vegetation. But for the propagation of a large quantity of buoyant wind-borne pollen for any distance the meteorologic condition of the country appears to be wholly unsuited.

Study such as that herein described clearly indicates the presence of pollens capable of causing hay fever, but the quantity of such pollens is so small that the atmosphere is comparatively free from them and the chain is thus broken.

As was pointed out by Durham,³ it is not beyond the limit of probability that in the previous study, on pollens from Sapporo, some of the fungi might have been inadvertently included in the pollen enumeration and an impression thus given that the air in Sapporo is rich in pollen. Unfortunately those slides have been destroyed. In the present study I have taken every precaution to avoid every source of technical error, and the figures presented here approach much more accurately the numbers of the pollens encountered. In these days of rapid yet comparatively inexpensive transportation, American sufferers from hay fever may find it convenient to visit Japan and enjoy complete freedom from this perennial disorder.

436 South Boyle Avenue

³ Durham, O. C. Hay Fever Among the Japanese, Arch. Otolaryng. **23** 121 (Jan.) 1936

VERTIGO

CLINICAL CONSIDERATION

BENJAMIN H SHUSTER, M D

PHILADLPHIA

With the more frequent employment of the labyrinthine or vestibular tests, the symptom vertigo has gradually become associated with otologic problems. Up to this time, the symptom, being somewhat of a cerebral sensation, has been classed with neurologic symptoms.

With the labyrinthine tests signs suggestive of an intracranial lesion are not only frequently pointed out but such a lesion is occasionally diagnosed some time before neurologic signs are clinically apparent. For this reason and because of the direct association of vertigo with internal disturbances of the ear, patients suffering from this symptom are referred to the otologist for consideration. For instance, a physician who had become subject to attacks of vertigo consulted his medical attendant and neurologist. His great concern was as to duration of his life or the possibility of permanent disability. He was about to undertake some changes in his plans requiring considerable financial investment and was uncertain as to his future physical ability to meet these changes. It was feared that he might possibly have a tumor of the brain. The labyrinthine tests during and between his attacks definitely excluded the probability of such a lesion and even pointed to some actual irritation of one of his labyrinths, which could in time be eliminated. He went ahead with his plans, and the future events justified this conclusion.

Frequently, one is called on to determine the justification of claims for compensation because of vertigo persisting after a head injury during the course of employment, as persons making such complaints are often suspected of malingering. The same situation arises during suits for damages in automobile accidents. Such persons as well as those with otologic conditions in whom vertigo develops come to the consideration of the otologist. The labyrinthine tests in all instances are of prime importance. There is only one answer to the problem. One

Read before the Columbus Society of Ophthalmology and Otolaryngology
Dec 5, 1938

From the Department of Neuro-Otology, Graduate School of Medicine of the University of Pennsylvania and the Department of Otolaryngology School of Medicine, University of Pennsylvania, service of Dr George M Coates

must become acquainted with the symptom and its variations as well as with the value and employment of the labyrinthine tests

DEFINITION

Vertigo is a subjective sensation of disturbed equilibrium often accompanied by a slight obscuration of consciousness. It may be manifested in the form of (1) giddiness, which is a mild degree of fainting with a momentary loss of one's balance, (2) sense of rotation, e.g., a sense of objects rotating about a person or of the person rotating about objects, and (3) pulsion, a veering of a person to one side or the other. All the foregoing sensations appear in the form of attacks, they are not continuous or constant.

Because of the various manifestations of the sensation, vertigo has been given various definitions. A common one is that it is an unpleasant sensation arising from one's feeling of a disturbed relation to surrounding objects in space. Hughlings Jackson described vertigo as "a sensation of motor origin resulting from a discord between the impressions which come from the labyrinth, the cerebellum, eye muscles and from other sources with which they coordinate or act in harmony. As a result of the discord of these impressions consciousness is affected with a distressing sensation known as vertigo." In other words, the symptom is due to disharmony in the organs of equilibrium. The subject is of interest to internists, otologists, neurologists and ophthalmologists, since this symptom is confronted in diseases related to these fields of medicine.

The symptom cannot be considered in the light of any one of these specialties alone to the exclusion of the other. Its character cannot be exclusively defined as belonging to one category or another. It is, therefore, deemed advisable to present a generalized view of the subject and to differentiate the condition when possible.

EQUILIBRIUM

Equilibrium is maintained by the cooperation of several factors: (1) afferent impulses to the brain, (2) efferent impulses through the motor tracts to the muscles and (3) coordinating centers in various parts of the brain.

The afferent impulses come from (a) superficial and deep sensibilities located in the skin, muscles, tendons and joints, (b) visual impressions, and (c) the vestibular portion of the internal ear.

Skin, Muscle and Joint Sense—Experiments on frogs whose cerebellums have been removed but who have optic lobes and cerebellums show that the animal can still maintain equilibrium satisfactorily, but when the hindlegs are skinned it falls like a log. It lacks the sense of touch necessary to maintain equilibrium (Ferrier). A man whose

soles are frozen with ethyl chloride has difficulty in maintaining equilibrium when his eyes are closed. A person with locomotor ataxia will fall over when he is deprived of his visual factor of equilibrium because of the interference with the pathways carrying sensory impressions from the skin and muscles and joints due to sclerosis of the posterior columns of the spinal cord. He falls when his eyes are shut (Romberg sign).

Visual Impressions—While one born blind can finally coordinate motion and equilibrate, vision is a great help in learning to walk. A person sees objects around him and coordinates movements accordingly. One learning to walk looks at his feet and gets along better. After movements become automatic the eyes are not so necessary, but still one equilibrates better when one's eyes are open and one sees. For the person with locomotor ataxia whose tactile sense is impaired, vision is important to maintain equilibrium. Even for the blind person with locomotor ataxia the steady gaze of the open eyes often is of some value.

Vision is important in equilibration, and this importance is illustrated by the creation of unusual movements in the field of vision, by moving objects and by faulty oculomotor apparatus. These factors impair one's association of the relative positions of objects in space. The disturbance of these relations in the mind creates a sense of vertigo, e. g., gazing at a moving object, nystagmus and erroneous projection on the retina cause distressing vertigo. Cyon caused disturbance of equilibrium in pigeons by putting prisms in front of their eyes.

While vertigo may result from some types of refractive errors, it is most manifest in those conditions in which stereoscopic vision is interfered with, e. g., muscle imbalance and diplopia.

Labyrinthine Function—This function is the most important factor for maintaining equilibrium in everyday life. The semicircular canals are the external organs which detect change of one's position in the various complicated movements of the body. The utricle and saccule detect change of movements in a straight line up and down or from side to side. The latter is supposed to be the function of the utricle while the saccule is supposed to detect motion vertically.

Experiments on the labyrinth date back to about 1824, when Florenz actually started the study of neuro-otology with the experiments on the semicircular canals of pigeons. He noted that when a horizontal canal was destroyed there was a lateral movement of the head with rotation of the body in the horizontal plane. When the posterior canal was obliterated, the head waved back and forth with a tendency to fall back. When the anterior canal was thus experimented on, the pigeon fell forward. Florenz thought that the canals controlled body movements and did not realize that he had opened a field for the study of equilibrium. His observations were confirmed, but interpretations were confusing.

In 1825 Purkinj recorded observations on other animals and also studied the concomitant movements of the eyes. Experiments on frogs by various observers (Goltz, Feilner and others) pointed to the connection of the canals with vertigo.

In 1869 Goltz advanced the theory that currents in the endolymph caused the stimulation in the canals.

In 1875 Mach, Breuer and Crum-Brown expressed the belief that partial pressure to or away from the ampulla caused the stimulation.

In 1892 Ewald showed that there was a difference in displacement of the head when the current was toward the ampulla or away from the ampulla.

In 1891 Breuer expressed the belief that the function of the otoliths is to sense the position of the head in space, since they are placed in two planes and their action depends on gravity.

Byrne in 1912 stated that pressure in the canals more logically explains stimulation than movements of current.

In 1892 Ewald drilled a hole in the posterior part of each of the semicircular canals and filled them with lead to block the flow of current at that end. A tubule was inserted in an opening in front of the first hole and a rubber bulb was connected with it, so that suction and pressure could be applied at will, to or away from the ampulla. The following conclusions were reached in regard to stimulation of the centers through the end organs: 1. A current toward the ampulla in the horizontal canal caused greater stimulation than when drawn from the ampulla. 2. The reverse was true in the vertical canal. A current away from the ampulla in the vertical canal caused the greater stimulation. 3. The eyes and head moved in the plane of the canal stimulated.

According to Hoyge's law, when the vestibular end organ of one side is stimulated, it causes contraction of the abductor ocular muscles on the opposite side and the adductor muscles on the same side, e. g., conjugate deviation, or the slow component of the eyes is away from the side being stimulated.

Hoyge in 1890 recorded a systematic study of the internal ear, including the foregoing law. From that study Bárány, Neuman, Rutin, Alexander and Kreidel got ideas for further study. In 1905 Bárány observed that douching of a suppurating ear with water that was too cold or too hot induced vertigo and a definite type of nystagmus. He found the same reaction in normal persons, and this was the beginning of the caloric test.

In 1909 Cajal demonstrated histologically the connection of the vestibular apparatus with the cerebellum by means of the horizontal canal. Later studies were made by Jones, Fisher, Weisenburg and Mills.

Eugene Lewis studied the mechanics. Shambaugh demonstrated the existence of more hair cells on one side of the crista ampularis than on the other.

The development of the routine tests is based on these studies. If one visualizes the anatomic location of the semicircular canals, all of the reactions to the various tests can be explained by these laws. The principal anatomic points to bear in mind are (a) The horizontal canals are in an almost horizontal plane (made horizontal by tilting the head 30 degrees forward). (b) The ampullae are on the anterior aspect. Therefore, when a person is rotated to the right (clockwise) the current will be made to flow to the patient's right—on the left side toward the ampulla and on the right side away from the ampulla, after rotation ceases.

1 Cold caloric douching will not affect the canals in the horizontal plane, but when the head is tilted back the chilled fluid will fall by gravity downward, when the right ear is douched it will fall to the right in a clockwise direction, away from the ampulla. With the head tilted forward, the current will flow toward the ampulla, anticlockwise and to the patient's left.

2 The vertical canals are so placed that the anterior ones are directed outward and forward 45 degrees to the sagittal plane of the head as well as to the coronal plane. The ampullae are placed forward. The posterior vertical canals are placed in a similar relation to the planes of the head but directed backward and outward. The anterior canal on one side is parallel to the posterior canal on the opposite side.

Cold caloric douching of the right vertical canal will cause the current to flow outward, downward and to the right in both canals on the side tested, toward the ampullae.

Rotation with the head 90 degrees forward will give an opposite reaction to that with the head backward. In each instance the vertical canal on each side is placed in a semihorizontal plane. With the head forward, when the patient turns to the right the current in all canals will flow clockwise, to the right in the front part of a circle. On the right side it will flow toward the ampullae and on the left side away from the ampullae. With the head 60 degrees back, when the patient turns to the right the current will flow clockwise in all canals but to the left in the back part of a circle with reference to the patient. With the foregoing positions in mind, all usual reactions, as appended in tables 1 and 2, can be explained. It is, of course, only necessary to know the routine normal responses in order to differentiate them from the abnormal responses.

All factors are not absolutely necessary to maintain equilibrium satisfactorily, but at least two are necessary for the purpose. When one factor is interfered with, the others compensate and carry on the func-

TABLE 1—*Responses to Bárány Tests of the Vestibular Apparatus (Routine)* *

Rotation Tests

- | | |
|---|--|
| <ol style="list-style-type: none"> 1 Spontaneously 2 Turn patient to the right 10 times in 20 seconds, head 30 degrees forward 3 Turn patient to the left 10 times in 20 seconds, head 30 degrees forward 4 Turn patient to the right 10 times in 10 seconds, head 30 degrees forward 5 Turn patient to the left 10 times in 10 seconds, head 30 degrees forward 6 Repeat tests 4 and 5 and ask patient (whose eyes are shut as they should be in all these tests) to say repeatedly in which direction he is turning, e g, right or left | <ol style="list-style-type: none"> 1 No nystagmus, vertigo, past pointing or falling 2 Horizontal nystagmus to left, 24 seconds in duration 3 Horizontal nystagmus to right, 24 seconds in duration 4 Past pointing to right with each hand, about 12 inches (30 cm) 5 Past pointing to left with each hand, about 12 inches 6 Patient will feel himself turning in direction of rotation while turning, when chair is suddenly stopped he will think he is turning in opposite direction for 26 seconds—indicates normal quantitative vertigo |
|---|--|

For the rotation tests the eyes should be closed and the horizontal canals only are tested, both sides are tested at the same time. The vertical canals are not usually tested by this method, although that can be done by repeating these tests with the head in such a position as to bring the canals into a nearly horizontal plane, e g, 90 degrees forward or 60 degrees backward. Reactions will take place accordingly.

Caloric Tests (Mass Irrigation with Water, 68 F)

- | | |
|---|---|
| <ol style="list-style-type: none"> 1 Douche the right ear with water 68 F head 30 degrees forward, note length of time required to produce reaction 2 After results of first caloric test have been quickly noted, bend the head back 60 degrees and again note reactions 3 Repeat tests 1 and 2 in left ear | <ol style="list-style-type: none"> 1 Requires about 40 seconds of douching, nystagmus will be rotary to left, past pointing will be about 8 inches (20 cm) to right with each hand, patient will have a sensation of turning (vertigo) to left and tendency to fall to the right 2 Same response as with test 1, except nystagmus is horizontal 3 Same response as with tests 1 and 2 but in opposite directions |
|---|---|

The caloric method tests each ear, as well as the vertical and horizontal canals, separately. When the head is inclined 30 degrees forward, the vertical canals are tested, when it is inclined 60 degrees backward the horizontal ones are tested. Sometime during the course of these tests, varying in degree with each patient, there is a certain amount of shock, pallor, nausea and perspiration, which is a normal reaction of the sympathetic nervous system.

Caloric Test (Kobrak Method), Minimal Stimulation

This method has been variously modified. One may take as a standard the use of 5 cc of water at 55 F and inject it with a syringe against the upper posterior part of the drum. Normally there is a latent period before the nystagmus appears, about 15 to 25 seconds. The duration of nystagmus is 60 to 100 seconds. The nystagmus is the same as with mass caloric douching, vertigo and past pointing are mild or are absent. If no reaction occurs, the quantity of water used is doubled after waiting awhile. It may thus be repeated several times, each time increasing the quantity of water. The labyrinth is said to be hyperactive when the nystagmus appears in less than 15 seconds or lasts longer than 100 seconds. It is said to be hypoactive when the latent period is prolonged or the duration is shortened or larger quantities of water are required to bring on the reaction. In cases of hypoactive labyrinths the temperature of the water used may also have to be lowered to that of ice water. Perversions and inversions of nystagmus can also be elicited by this method.

Galvanic Method

A galvanic plate is used (direct current), or special batteries, having a positive pole (anode) and a negative pole (cathode) are employed. With the bipolar method one pole is applied to each ear, so that only 1 or 2 milliamperes of current is used. The nystagmus produced is in the direction of the flow of the electric current, which is from the positive to the negative pole. When the positive pole is applied to the right ear there is a rotary nystagmus to the left, vertigo to the left and falling and past pointing to the right (same as with cold caloric test). Changing the position of the head backward or forward makes no difference. The unipolar method is more satisfactory, the positive electrode is applied to the tragus and the other pole to a distant part. In this manner more current, 4 milliampères, is required. If less current is required, the labyrinth is said to be hyperactive, if more current is required, it is said to be hypoactive. The reaction is present even when the labyrinth is not functioning—through the eighth nerve, if that is not degenerated, as in a recently destroyed labyrinth.

If all the responses are present, either normal or more or less proportionately exaggerated or diminished, it means that both inner ears are intact, that there probably is not present any lesion in either of the cerebellopontile angles and that if any vertigo exists it is probably due to some external cause e g, toxic irritation of the labyrinth, focal infection in the tonsils, teeth, kidneys, gallbladder or gastrointestinal tract.

* The rotation test does not disturb the patient so much as the caloric method, and both labyrinths are tested at the same time. The caloric method causes sickness of the patient, but one side alone can be tested. The Kobrak method is a good method because it does not disturb the patient as much as the mass caloric method and tests one ear at a time, but the study of vertigo and pointing is not as satisfactory.

TABLE 2—Normal Vestibular Reactions in Various Planes*

Rotation Tests	Nystagmus†	Rotation		
		Vertigo	Past Pointing	Falling
Turn to right, head 30° forward	Horizontal to left	To left in horizontal plane	To right	
Turn to left, head 30° forward	Horizontal to right	To right in horizontal plane	To left	
Turn to right, head 60° back	Rotary to right	To left in horizontal plane and sensation of falling to right when head is brought up	To right	To left on getting up
Turn to left head 60 back	Rotary to left	To right in horizontal plane and sensation of falling to left when head is brought up	To left	To right on getting up
Turn to right, head 90 forward	Rotary to left			
Turn to left, head 90 forward	Rotary to right			
Turn to right, head 120 forward		To left in horizontal plane and sensation of falling to left when head is brought up	To right	To right on getting up
Turn to left, head 120 forward		To right in horizontal plane and sensation of falling to right when head is brought up	To left	To left on getting up
Turn to right, head to right shoulder	Vertical down		Up when head is brought up	Backward on getting up
Turn to left head to right shoulder	Vertical up		Down when head is brought up	Forward on getting up
Turn to right head to left shoulder	Vertical up		Down when head is brought up	Forward on getting up
Turn to left head to left shoulder	Vertical down		Up when head is brought up	Backward on getting up
Turn to right, after head is turned 45 to right and inclined to right shoulder 90	Oblique down to left when head is brought up			
Turn to right after head is turned 45 to left and inclined to right shoulder 90°	Oblique down to right when head is brought up			
Cold water, 68 F				
Douche right ear, head 30 forward	Rotary to left	Sense of falling to left	To right	To right
Douche left ear, head 30° forward	Rotary to right	Sense of falling to right	To left	To left
Douche right ear, head 60 back	Horizontal to left	Sense of falling to left	To right	To right
Douche left ear, head 60 back	Horizontal to right	Sense of falling to right	To left	To left
Douche right ear, head 120° forward	Horizontal to right	Sense of falling to right	To left	To left
Douche left ear head 120° forward	Horizontal to left	Sense of falling to left	To right	To right
Hot water, 112 F				
Douche in same positions as with cold water	Opposite to that with cold water	Opposite to that with cold water	Opposite to that with cold water	Opposite to that with cold water

* These reactions are in accordance with the following physiologic laws: 1. The eyes are always drawn (slow component) in the direction of movement of the endolymph (nystagmus opposite). 2. Vertigo is always in a direction opposite to the movement of the endolymph. 3. Past pointing is always in a direction opposite the vertigo. 4. Falling is always in a direction opposite to the vertigo.

† The description indicates the direction in relation to the patient.

tion For this reason a blind man can maintain his balance with the aid of his labyrinths, his muscle and joint sense and his sense of touch A person with tabes whose eyes and labyrinths are intact but not his spinal pathways will maintain his equilibrium with his labyrinthine and visual functions When he closes his eyes, he falls A deaf-mute having no labyrinthine function maintains his equilibrium with his remaining functions Sudden ablation of the labyrinth by disease will cause unpleasant vertigo for a while, but compensation takes place and the patient will get along

Jones and Ocker showed that human beings are more capable of detecting motion and change of motion in a dark elevator when the vestibular apparatus is normal They also pointed out that in blind flying pilots make considerable use of their vestibular sense This emphasizes the importance of the vestibular apparatus

PROBABLE PATHWAYS OF VERTIGO

Jones postulated separate vertigo tracts running from the internal ear to the brain On the basis of clinical manifestations in certain cases as demonstrated by vestibular tests, he found that there must be separate pathways carrying vertigo impulses as follows (1) a group of fibers from the horizontal semicircular canals to the vestibular nuclei (2) group of fibers from the vertical canals to these nuclei, (3) fibers from the horizontal canals to the cerebellar nuclei through the restiform body (inferior cerebellar peduncle), (4) fibers from the vertical canals to the cerebellar nuclei through the middle cerebellar peduncle (brachium pontis) and (5) all the fibers from the cerebellar nuclei, which cross to the opposite temporal lobe by way of the superior cerebellar peduncle (brachium conjunctivum)

Spiegel and Alexander, after experimenting on animals and observing and studying recorded cases of tumor of the brain, found that the temporal lobes particularly and also parts of the frontal lobes (centio-occipital region) are the seat of vertigo perception None of the pathways have been proved histologically

ETIOLOGY

Normally the greatest factor in maintaining equilibrium is the internal ear Tonus impulses are sent to the skeletal muscles, which are equal on each side There may or may not be definite tracts in the brain carrying these impulses from the labyrinth to the brain and to the muscles As long as both internal ears and other pathways are intact, equilibrium is maintained Any deviation caused by irritation or destruction of any normal factors concerned in maintaining equilibrium results in vertigo

The etiologic factors which produce vertigo are considered in four groups

1 General systemic conditions, such as cardiac disease, renal disease, arteriosclerosis, pernicious anemia and leukemia, which arise from disturbance of the labyrinthine circulation, e g, anemia, hyperemia or actual hemorrhage into the labyrinth, may cause vertigo Nitrogen embolism is the cause of vertigo in caisson workers Drugs like quinine and the salicylates, tobacco, infections due to diseased teeth, tonsils and sinuses, inflammations of the gastrointestinal tract, including foci of infection anywhere in the tract as well as in the gallbladder or the colon, and even dietetic errors can cause vertigo Patients have been relieved of vertigo by removal of such foci and by attention to the gallbladder, bowels and dietetic errors (excessive proteins and sugars)

2 Ocular conditions, principally muscle imbalance, produce this symptom

3 Diseases of the ear also give rise to vertigo

4 Diseases of the brain are an etiologic factor

Among the general conditions causing vertigo may be included faulty water metabolism causing a waterlogging of the internal ear and also an excess of sodium in the body Vertigo in such cases can be controlled by reduction of the sodium intake in the diet and the administration of massive doses of ammonium chloride an acid-forming salt which prevents retention of sodium in the body

Ocular conditions causing vertigo are chiefly those of muscular imbalance Vertigo is most marked when the patient looks in the direction of the paretic muscle It disappears when the eyes are closed and diminishes when the eyes are turned from the side of the paretic muscle Any cause producing diplopia will produce vertigo Poorly adjusted glasses, particularly on persons who are beginning to wear bifocal lenses, will cause vertigo Correction of this factor relieves the vertigo

A personal communication from Dr Edmund B Spaeth concerning the status of vertigo in patients coming to the ophthalmologist for the relief of this symptom, gives the following data

(a) The ocular condition which is commonly the cause of vertigo is that of muscle imbalance Hyperphoria comes first, exophoria second and esophoria last Vertigo is present even though no true diplopia is noted by the patient Naturally frank diplopia from paralysis of an oculomotor nerve is an outstanding cause of vertigo

(b) In the case of diplopia the wearing of a patch over one eye is necessary In the case of hyperphoria correcting prisms should be worn, or if the hyperphoria should be the result of paralysis of a levator muscle, the treatment should be surgical In double hyperphoria, vertigo is rather less common In exophoria prism exercises are of outstanding value In esophoria orthoptic exercises with the stereoscope are of value

(c) The type of vertigo or the sensation of which the patient usually complains is that of dizziness, unsteadiness and usually squeamishness on arising in the morning. The patient with vertigo seems to move rather than the outside world moving about him. The symptoms are always aggravated by fatigue, even though the vertigo may have originated with the use of the eyes. Such patients are remarkably susceptible to fatigue and do not stand concerted effort well.

Aural conditions causing vertigo are as follows:

1. In the external auditory canal foreign bodies or otitis may cause vertigo by increasing labyrinthine pressure or irritation of the ear drum.

2. In the middle ear catarrhal otitis media and blocking of the eustachian tube may cause vertigo, which is relieved by inflation. Suppuration of the middle ear, either acute or chronic, may cause vertigo through infection of the labyrinth. Mild vertigo in the presence of chronic suppurative otitis media is a symptom calling for proper attention to the ear. It is an indication of perilymphitis, and an actual attack of labyrinthitis or intracranial invasion by the infection is threatened. Sudden onset of vertigo, nausea and vomiting associated with nystagmus, ataxia and deafness in the presence of a suppurating ear are the manifest signs of an actual invasion of the labyrinth by infection. When vertigo is a prominent symptom in cases of chronic suppurative otitis media with signs of intracranial invasion, the cerebellum may be the organ involved. A sudden onset of the foregoing group of symptoms of labyrinthitis without the presence of suppuration has been described by Ménière as due to a hemorrhage into the labyrinth. This syndrome has been, since his description, called Ménière's disease. He was the first to call the attention to the fact that this group of symptoms was due to disease of the inner ear. Many causes acting on the inner ear have since been found to produce this symptom complex. All the causes of vertigo enumerated under general conditions causing vertigo have been described by this name.

Intracranial lesions causing vertigo may be tumors in the frontal or parietal lobes as well as in the cerebellum. Weisenburg, in a study of a number of cases of tumor of the brain with reference to vertigo, concluded that vertigo is caused by a great increase in intracranial pressure and that tumors of the posterior fossa are therefore more likely to cause vertigo. He found that no characteristic type of vertigo was caused by any type of tumor and that tumors may exist without causing vertigo. Lesions must involve the vestibular tracts by destroying them. Gliomas do not destroy these fibers.

Trauma to the head is often followed by vertigo for a long time and is probably due to concussion of the brain. This is of importance in industrial cases in which, following trauma, a person claims compensation for disability caused by vertigo. Persons with such injuries are often suspected of malingering. Vestibular tests, however, give some inkling as to the reliability of their claims.

Many persons with vertigo show some hypoactivity or hyperactivity while some show actual signs of intracranial involvement, such as lesions of the cerebellopontile angle. This may be due to petechial hemorrhages of the brain, as shown by Bruner in experimental trauma of the head of animals.

Vertigo is difficult to differentiate as being caused by one lesion or another. In general, it may be said that rotational vertigo is associated with aural lesions. The patient with the severe form feels a sense of rotation of objects around him or he around the objects. This symptom is usually associated with a vestibular type of nystagmus (slow and quick component) and becomes worse when the eyes are directed toward the side of the quick component. Deafness, nausea, vomiting and ataxia, occur and the patient manifests a tendency to rotate or fall in a direction opposite the quick component of the coexisting nystagmus. The symptom has a tendency to subside within ten days or two weeks. This constitutes the picture of labyrinthitis when suppurative otitis media is present. This picture is also true in cases of Meniere's syndrome in which no suppuration of the ear is present. In cases of a milder nature the attacks of vertigo appear in spells, and the characteristics are the same, except that they are milder in degree. When a patient is seen during an attack of vertigo, the facts concerning an irritable labyrinth should be helpful. An irritable labyrinth causes the eyes to deviate (conjugate deviation) to the opposite side, with resultant nystagmus (quick component) to the affected side. The ataxia or tendency to fall will be toward the opposite side (opposite the quick component). When the vestibular tests are being performed, patients frequently volunteer the information that the reactions simulate their attacks.

If these facts can be elicited, they point more definitely to a labyrinthine irritation. This is true regardless of the irritant, whether it is toxic, circulatory or aural. Such an irritation would less likely be due to an intracerebral condition.

It is said that with certain conditions of the brain, such as multiple sclerosis or encephalitis there may be a form of vertigo described as lateropulsion, a sensation of being pushed to right or left. The characteristics of the vertigo associated with each condition, however, are not sufficiently constant to be clinically of differential value.

DIAGNOSIS

Diagnosis of the cause of the vertigo must be made only after complete physical examination to determine the presence of cardiac or circulatory disturbance, renal disease or disease of the gastrointestinal tract and neurologic examination to detect any cerebral disease. A focal

infection must be borne in mind as important. Another important measure in the diagnosis is the performance of the vestibular tests.

These tests may be the only clue to the existence of an intracranial lesion. They may indicate by hyperactivity or hypoactivity the presence of some focal infection or provide an objective proof of some intracranial traumatism in a patient suspected of malingering. It is felt that the vestibular tests are of the utmost importance in the study of vertigo, and a brief outline is given in table 3 together with probable interpretations.

TREATMENT

Treatment consists of finding the cause and eliminating it when possible. Tumors of the brain are of course neurosurgical problems. When

TABLE 3—*Principal Abnormal Vestibular Responses for Diagnosis and Localization of Intracranial Lesions*

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Spontaneously	Lesions of the Posterior Fossa
1 Vertical nystagmus	1 No sensitivity to tests
2 Horizontal nystagmus to one side	2 General depression of reactions
3 Poor movements of pelvic girdle	3 Lesion usually on side of depression or other abnormality
	4 When both sides show abnormalities, lesion usually in midline
After Testing	Supratentorial Lesions
1 Perverted nystagmus	1 Usually marked sensitivity to tests
(a) Oblique nystagmus	
(b) Vertical nystagmus	
(c) Horizontal instead of rotary nystagmus and vice versa	
2 Inverted nystagmus	2 Usually exaggerated responses
3 Large amplitude of nystagmus	3 With lesion of the midline—similar involvement of each side
4 Small rapid ocular movements	4 With interference with vertical canal—lesion usually on the opposite side
5 Dissociated ocular movements	5 With perverted response of horizontal canal to caloric test—lesion on the same side
6 Conjugate deviation	6 Conjugate deviation usually to side of lesion
	Syndrome of Lesion of Cerebellopontile Angle
	1 Loss of function on the affected side, including hearing
	2 Impaired responses from vertical canals and probably perverted responses from the horizontal canal on the opposite side
	3 Both 1 and 2 may be present
<hr/>	

an intracranial lesion has been excluded by neurologic and by vestibular examination the problem resolves itself into finding and eliminating other causes. In the presence of a discharge from the ear particularly a chronic one, this would be the most likely cause of trouble. Perilabyrinthitis is a frequent cause of recurring attacks of vertigo, and radical mastoidectomy often affords relief. Severe attacks of vertigo and ataxia in association with either acute or chronic otitis media point to a possible labyrinthitis or cerebellar abscess and should be treated as indicated.

Patients have been relieved of vertigo by removal of infected teeth and tonsils and by proper treatment of a diseased sinus. Gastrointestinal

disturbance and disease of the gallbladder have proved to be frequent offenders. Dietetic irregularities should be corrected. Circulatory disturbances in persons past middle age are often the cause. Reduction in activities and avoidance of overeating correct these conditions. Anemia and low or high blood pressure should be corrected.

When one fails to discover and eliminate probable causes, there are methods of symptomatic treatment which have offered relief. One method is a medical treatment recommended by Furstenburg and his co-workers, that is, reduction of the sodium content of the body. Dedring and Mygind insist on the additional importance of water-logging of the labyrinth as a potent factor in the production of vertigo and advise a reduction of fluid intake.

The treatment consists in the reduction of salt intake in the diet, reduction of fluid intake and the administration of large doses of ammonium chloride three times a day. General care of the patient's health, e. g., the anemia, bowel irregularities, etc., is an important adjunct to the special treatment. Three grams of ammonium chloride are taken with each meal in capsules (six capsules each containing $7\frac{1}{2}$ grains [0.492 Gm.] of ammonium chloride). This is given for three days and then omitted for two days. It may be continued indefinitely without untoward effect but with relief from symptoms.

Another method is recommended by Dandy. It is the surgical severance of the vestibular portion of the eighth nerve. While it is a simple operation in his hands, it really is a formidable procedure and should be resorted to only as a last resort. It must be borne in mind that there are patients who were almost ready to submit to this operation but hesitated and were finally relieved by some medical form of treatment. It should be looked on as a palliative measure and not a cure for the condition. Vertigo is not a disease of the eighth nerve comparable to neuralgia of the fifth nerve. Vertigo with its associated symptoms of nausea and vomiting form part of the so-called Menière's syndrome and is a manifestation of various conditions.

Injection of a solution of formaldehyde into the inner ear has also been recommended.

Surgical trephination of the saccus endolymphaticus has been advocated by Portmann, and Mosher has proposed opening the superior semicircular canal in the middle fossa and packing it. The vestibular function of the labyrinth is thus destroyed.

CLIMATIC FACTOR IN MASTOIDITIS

NOAH D. FABRICANT, M.D.

CHICAGO

A vast literature deals with climate in general terms. In the past, physicians have thought in terms of long-continued effects on the human organism and therefore of climate rather than weather. One of the real difficulties with the meteoropathologic literature is the fact that it almost invariably deals in general terms. More recently, the climatic factor as expressed in the weather and the season has begun to receive considerable attention. Huntington¹ in particular has studied the role of the American climate in a whole series of human reactions. Dexter² has described the associations of weather and behavior and Mills³ the importance of the storm track for a variety of diseases. Petersen⁴ has dealt exhaustively with the day by day influence of weather on the normal person and on the patient.

Since the weather and the season function together as perhaps the most important environmental factor from the time a human being is conceived to the time he dies, the fact that they can be measured with considerable accuracy affords a distinct advantage. Any number of environmental factors, such as emotion, diet, infection, intoxication and fatigue, influence a person, but it is extremely difficult to evaluate them. Definite alterations, however, such as those involved in daily changes of temperature, are measurable, although there is not always an absolutely uniform effect from meteorologic changes, because individual members of a community may protect themselves to different degrees.

There must be some reason why the acute infections reach a peak in the spring and not in the summer, why in certain years pandemics of influenza sweep the world, the disease being negligible at other times, and why certain persons remain resistant and others acquire an infec-

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1 Huntington, E. *Civilization and Climate*, ed. 3, New Haven, Conn., Yale University Press, 1924.

2 Dexter, E. G. *Conduct and the Weather. An Inductive Study of the Mental Effects of Definite Meteorological Conditions*, New York, The Macmillan Company, 1899.

3 Mills, C. A. *Climate as a Potential Factor in the Etiology of Exophthalmic Goiter and the Other Metabolic Diseases*, *Endocrinology* **16**: 52, 1932.

4 Petersen, W. F. *The Patient and the Weather*, Ann Arbor, Mich., Edwards Brothers, Inc., 1934-1938, vols. 1-5.

tion That bacteria penetrate the mucous membranes at certain times and that there are definite periods of greater or lesser susceptibility is known Nedzel⁵ has demonstrated such penetration of bacteria culturally as well as histologically

Recent investigations by Sargent⁶ concerning the common cold in normal young men observed under normal conditions of activity and subject to the same meteorologic conditions make evident that when a person is observed from day to day the initiation of a "cold" or a "sore throat" is always seen to be preceded by an episode involving a fall in temperature The first stage of infection from the mucous membranes includes not only the presence of a suitable virus but the coincident biologic phase that makes penetration possible

To avoid confusion it should be kept in mind that the human organism must adjust itself periodically to two wholly different types of atmosphere A sudden fall in atmospheric temperature, usually associated with the passage of a polar air mass (cold front, or polar front), brings with it not only a change in temperature but lessened humidity and increase in barometric pressure On the other hand increasing temperature is characterized not only by a warmer air mass (warm front, or tropical front) but by greater moisture content and lower barometric pressure

The precipitation of disease occurs in the wake of a cold front when the functional status of the mucous membranes of the nose and throat has changed A few hours to one or more days may elapse before the clinical symptoms make their presence felt It is this latent or incubation, period that not infrequently complicates the picture because the actual initiation of the disease must follow the cold front closely

One cold front may be passed clinically without harm It is the superimposed cold front, striking the human organism before recovery has been possible, that results in further damage A second insult may contribute to further biologic inadequacy It is the infall of cold air that is pathogenic, either directly because of the meteorologically induced vascular spasm or indirectly because of changes that follow the vascular spasm

In the presence of a polar front the effect of cold is only one of the factors that precipitates change Atmospheric pressure, humidity and electrical potential and ionization, to mention only a few, differ, and the organism responds to an environmental change that is complex just as its own response is complex If the volume of the brain can

5 Nedzel, A J, and Arnold, L Influence of Eggwhite upon the Absorption of Bacteria from the Intestinal Tract, *Proc Soc Exper Biol & Med* **28** 358, 1931

6 Sargent, F Studies in the Meteorology of Upper Respiratory Infections, *Bull Am Meteorol Soc* **19** 385, 1938

be changed by alterations in atmospheric pressure as Schildbrand⁷ has demonstrated, the circulation of the brain will be changed and if the circulation of the brain is changed one may anticipate alterations in the medullary centers, in the respiratory rate and in the pressure levels. Physiologists are just beginning to suspect the existence of such effects.

The vasomotor and biochemical changes induced in the population when a mass of polar air passes over have been described in detail by Petersen. At first the capillaries are less permeable, the blood pressure is increased, the tissues are less hydrated, and the blood is relatively more alkaline (carbon dioxide content decreased, p_{H} increased). In general, this might be termed a period of sympatheticotonia which finds its reflection particularly in the peripheral tissues, including the mucous membranes of the nose and throat. Gradually the vascular spasm is dissipated, the vessels become dilated to accommodate the increased demand of the organism for greater oxygen consumption, the blood pressure falls, the membranes become more permeable and the tissues become relatively more acid and hydrated. At this time the opportunity for bacterial penetration presumably is greater. In this connection the work of Burrows⁸ has been particularly significant.

Later the bacteria having penetrated into the mucous membranes disease is begun by local reactivity of the tissues, dissemination from the zone of penetration or localization in the body after dissemination. Localization in the tissues will be favored immediately by the alteration induced by vascular spasm.

Thus, the shift from one type of atmospheric mixture in which the group is existing to one diametrically opposite in most of its qualities is definitely associated with a shift in the physiologic phase, and under normal conditions the population is constantly swinging from a phase in which vascular spasm is enhanced to one in which vascular dilatation is augmented and vice versa, the condition being one of continuous flux in practically every physiologic and biochemical balance. As such fluctuations form a constant biologic phenomenon with the meteorologic accentuation existing in the northern hemisphere, definite alterations in resistance, susceptibility and bacterial invasion become evident. These environmental forces influence the speed, the direction, the amplitude and the phase interval of the metabolic processes and often produce the coup that pushes the organic mechanism over the edge of normality.

CLINICAL OBSERVATIONS

During 1938, 92 mastoidectomies were performed on children by the attending otologic staff of a pediatric hospital. I have selected 5 cases from the group to illustrate the influence of day by day meteorological

⁷ Schildbrand, cited by Petersen,⁴ vol 2, p 4

⁸ Burrows, H. Some Factors in the Localisation of Disease in the Body, London, Bailliere, Tindall & Cox, 1932

logic and seasonal changes on the clinical course of mastoiditis. Simplified meteorographs have been prepared from the United States government meteorologic data supplied by the local weather bureau. A comprehensive meteorograph would include daily temperature, barometric pressure, average wind velocity, sunshine scale and precipitation. For purposes of simplification, however, the high and low range of daily temperature may be regarded as an adequate index of meteorologic change.

REPORT OF CASES

CASE 1—A white boy 5 years old had a "cold" about Oct 13, 1938 (A, chart 1). Four days afterward there was pain in the right ear (B, chart 1), with suppuration

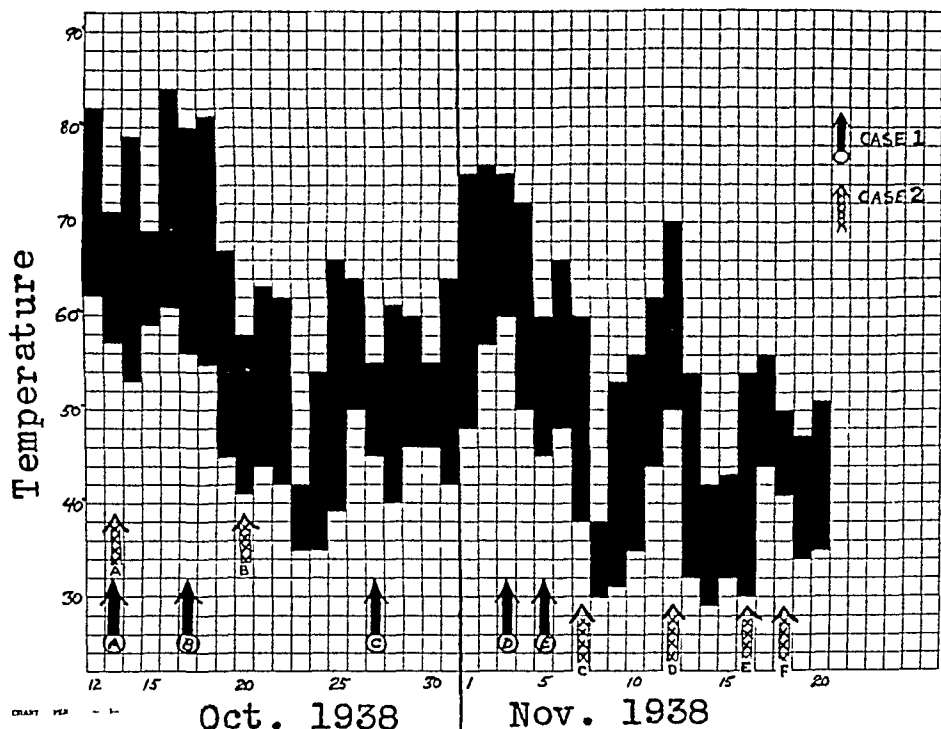


Chart 1—Atmospheric temperature as involved in the clinical episodes of cases 1 and 2

two days later. On October 27 the right postauricular area was noticeably swollen and tender (C, chart 1). A diagnosis of "surgical mastoid" was made on November 3 (D, chart 1) when the child was admitted to the hospital. Operation was performed on November 5 (E, chart 1). At this time the sinus plate was found to be necrotic and the sinus was exposed.

The association of meteorologic events and clinical episodes is clear. A "cold" began on October 13, with a mass of cold air passing over the city. The next polar front, on October 17, was associated with pain in the right ear and, as the mass of polar air continued, suppuration in the middle ear. Another polar front induced postauricular swelling and tenderness on October 27. Each succeeding polar front acted as a stinging blow and finally operation became necessary (November 5).

CASE 2—On the same day (Oct 13, 1938) on which the child in case 1 "took cold," another patient, a 10 year old girl, had an acute "head cold" (*A*, chart 1) She was kept in bed for two days She felt better for a few days and then had pain in the right ear, the drum ruptured spontaneously, and suppuration commenced on October 20 (*B*, chart 1) The right ear drained profusely On November 7 (*C*, chart 1) the left middle ear began to suppurate For the next five days the drainage was profuse, cervical adenopathy became evident, and the mastoid was tender On November 2 (*D*, chart 1) the patient was admitted to the hospital On November 6 (*E*, chart 1) the preoperative temperature reached its peak at 103.2 F Bilateral mastoidectomy was performed on November 18 (*F*, chart 1)

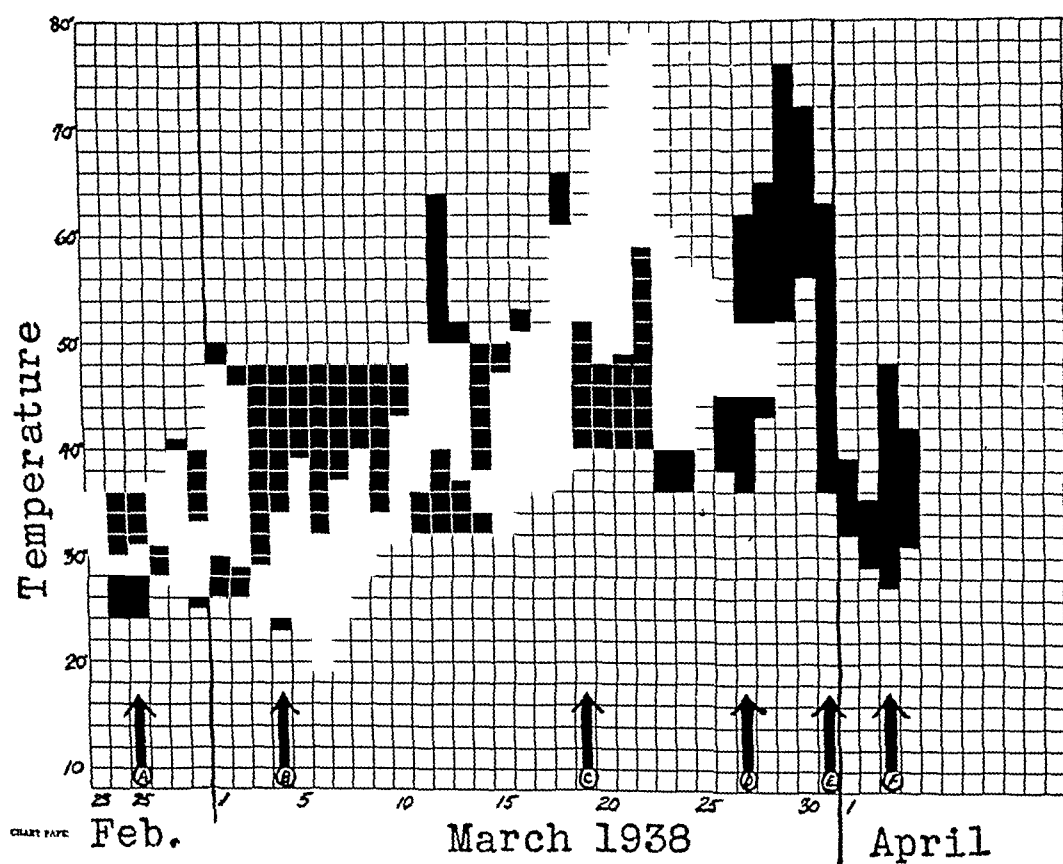


Chart 2—Atmospheric temperature as involved in the clinical episodes of case 3

As in the preceding case, the "head cold" began coincidentally with a cold front on October 13 The patient was better for a few days, but when a second polar front occurred the right ear began to suppurate There followed a series of incidents associated with successive polar fronts When another polar front appeared on November 7, the left ear began to suppurate The patient was hospitalized on November 12 With the advent of the next serious cold front the preoperative temperature attained its highest level on the second coldest day (November 16) of the five week illness

CASE 3—A 10 year old girl began to complain of pain in the left ear on Feb 25, 1938 (*A*, chart 2) Shortly afterward the left ear began to suppurate On March 4 the right ear commenced to discharge (*B*, chart 2), draining intermittently

until March 19, when the child complained of severe pain, the mother reported that at this time the patient vomited and had fever (*C*, chart 2). The child was lethargic for one week, during which the ear again suppurated and the acute symptoms subsided. On March 27 a similar symptomatic episode (*D*, chart 2) occurred, there was pain, fever and vomiting. As soon as the ear suppurated the acute symptoms subsided. On March 31 the mother observed a swelling behind the left ear (*E*, chart 2). The child was brought to the hospital, where a diagnosis of mastoiditis on the left with zygomatic involvement was made. A mastoidectomy (*F*, chart 2) was performed on April 2.

From the meteorograph it will be noted that an earache on the left with subsequent suppuration followed a clinical episode associated with a polar front. A

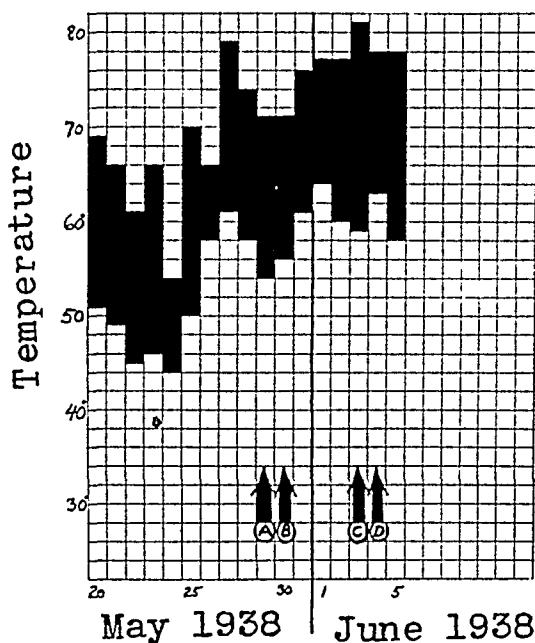


Chart 3—Atmospheric temperature as involved in the clinical episodes of case 4

subsequent polar front was associated with suppuration in the right ear (March 4). There was a period of relative symptomatic quiescence with the advent of a warm front, but on March 19, after another cold front, the child had pain and fever and vomited. One week later, on March 27, the acute symptoms reestablished themselves after a marked polar front. On March 3 another severe cold front induced the major effect of autonomic disturbance, and the child had surgical mastoiditis.

CASE 4—The mother of a 6 month old boy reported that the baby had earache on the right side on May 29, 1938 (*A*, chart 3). There was no history of a "cold." The following day a swelling (*B*, chart 3) in the right postauricular region was observed. On this day (May 30) a paracentesis was done. Irritability and fever continued. On June 3 the child was hospitalized, with a diagnosis of mastoiditis on the right with subperiosteal abscess (*C*, chart 3). A mastoidectomy (*D*, chart 3) was performed on June 4.

The meteorologic data indicate that the onset of the earache and the subsequent postauricular swelling occurred coincidentally with a polar front on May 29 and 30. This episode followed a severe cold front several days before. A second polar front, on June 3, was sufficient to "balloon" the clinical symptoms into full blown mastoiditis.

CASE 5—A 5 year old boy had a "cold" (*A*, chart 4) on Dec 22, 1937. Two days later a paracentesis of the right ear drum (*B*, chart 4) was done on a bulging, highly inflamed drum membrane. On December 28 the boy had pain in the left ear (*C*, chart 4). Three days later, on December 31, he was admitted to the hospital (*D*, chart 4). At this time a paracentesis of the left ear drum was done. On January 1 (*A*, chart 4) and 2 (*F*, chart 4) the temperature fluctuated

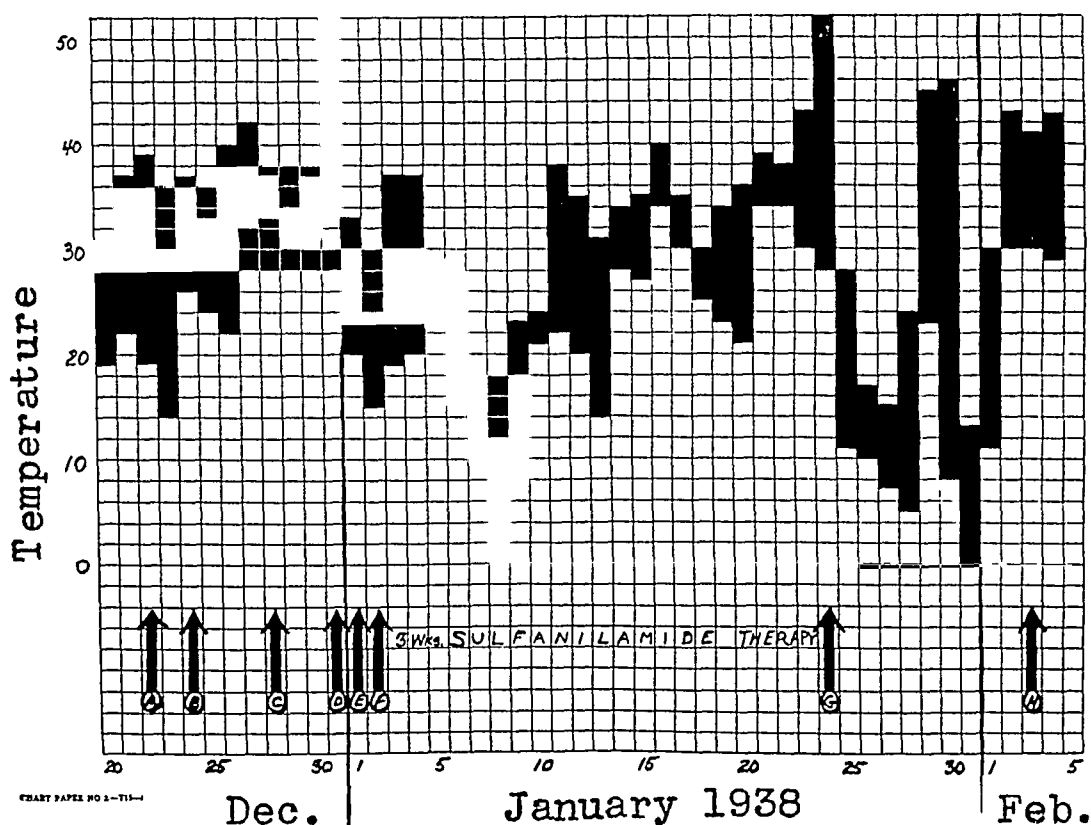


Chart 4—Atmospheric temperature as involved in the clinical episodes of case 5

between 102.8 and 101.6 F. The patient was toxic. Sulfanilamide therapy was given for three weeks, but the mastoiditis did not respond sufficiently to avoid the necessity of a mastoidectomy (*G*, chart 4), which was done on Jan 24, 1938. The patient was discharged from the hospital (*H*, chart 4) on February 3.

In this case the role of the meteorologic events seems relatively simple and clearcut. A "cold" and paracentesis of the right ear drum occurred in association with an initial polar front. A second polar front was associated with pain in the opposite ear. At the onset of a third polar front a paracentesis was required for the left ear. At this time the patient was hospitalized. On January 1 and 2 the temperature mounted. The child was given sulfanilamide therapy. It will be noted that the sulfanilamide was inadequate during a series of severe polar fronts (January 7 was the coldest day of the winter). Finally, the child was operated on (January 24).

CONCLUSION

The climatic factor in mastoiditis, as expressed in terms of the weather and the season, can be measured with considerable accuracy

The precipitation of this disease most often occurs in the wake of a fall in atmospheric temperature (cold front or polar front), when the functional status of the mucous membranes of the nose and throat has changed

Five cases of mastoiditis in children are described to illustrate the influence of day by day weather and seasonal changes on the clinical course of mastoiditis

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EXPERIENCES WITH SULFANILAMIDE THERAPY FOR OTOGENOUS INFECTIONS

WITH SPECIAL REFERENCE TO MASKING OF THE
CLINICAL COURSE

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With the advent of sulfanilamide, a new form of chemotherapy has resulted in a tremendous advance in the treatment of certain types of otitic infection. The literature is now replete with many theoretic, experimental and practical considerations of the value of this remarkable drug. The outstanding result of its use for otogenous infections is the astounding improvement of the prognosis in conditions, such as meningitis, which hitherto were regarded as utterly hopeless. In the literature before the use of sulfanilamide, recovery in cases of streptococcic meningitis was reported, but it was comparatively rare. In July 1935 Gray¹ presented a summary of the literature on this subject. He found 66 cases of recovery, including his own, reported in the last thirty-five years. He felt that streptococcic meningitis was fatal in at least 97 per cent of cases.

In the experience of most otologists the outstanding fact during the greater part of the past twenty-five years was the futility of any measures in behalf of sufferers from this hopeless condition. During the first fifteen years of the period, it was customary to have the patients admitted to the medical or the neurologic service, and, as the prognosis was regarded as hopeless, only palliative measures were used—morphine, in large doses, being the drug usually administered. Any operation performed was in the nature of an antemortem procedure.

During the second period, i e., the ten years preceding the advent of sulfanilamide, knowledge of the pathways of infection to the meninges was considerably increased by histologic studies of petrositis. As this

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1 Gray, H J. Streptococcic Meningitis. Report of a Case with Recovery, J A M A **105** 92 (July 13) 1935

otic complication is responsible for the largest number of cases of meningitis, the studies soon led to a keen interest in the various clinical aspects of petrositis and their diagnosis, and the surgical indications for intervention. Attention was directed also to other avenues of invasion of the meninges. The involvement may occur, for instance, by way of the middle ear, through dehiscences in the roof or a destructive process in the region, through the mastoid proper, or by way of the labyrinth, it may follow sinus thrombosis, either by direct extension or by embolic deposits in the meninges occurring during a general invasion.

As a result of these studies more thorough surgical eradication of the otitic focus was done, new operative procedures for drainage of the petrosal lesions were devised, and various measures were employed to combat the meningeal infection, such as chemotherapy with Pregl's solution (iodine) or mercurochrome, intracarotid injection of various dyes, repeated blood transfusions, specific serums, Kubie's forced spinal drainage or repeated lumbar taps.

During this period, despite these operative and nonoperative procedures, only an occasional recovery was recorded. The mortality still was placed at over 97 per cent. While recoveries were few, it was not infrequently observed that the measures employed resulted in prolongation of the illness.

We now come to the present treatment—in use for less than two years. The results from the use of sulfanilamide reported from all over the country and abroad have been amazing. It must be remembered that a majority of recoveries from otitic meningitis occurred in instances in which the focus in the temporal bone had been thoroughly eradicated in conjunction with the proper administration of sulfanilamide. In other words, this form of therapy seems to be ineffective if the original focus is not removed. While sulfanilamide will clear body fluids infected by streptococci, its action is apparently less effective on streptococci in an active osseous lesion. We have demonstrated to our satisfaction that unless proper surgical measures are employed the only effect of sulfanilamide is partial control of the disease and a tendency to prolong its course.

A form of medication so recent must necessarily give rise to a divergence in opinion regarding indications, methods of administration, dosage and prophylactic use.

We have been opposed to the indiscriminate administration of sulfanilamide for infections of the upper part of the respiratory tract, many of which run a self-limited course in any event. The free use of this preparation, aside from the dangers of toxicity, frequently obscures the clinical picture and often gives rise to a latent course of the disease.

Latent forms of mastoiditis and its complications are known to occur. Our point of view regarding the administration of sulfanilamide for minor infections of the upper part of the respiratory tract is necessarily subject to change, however, for the present we use the drug only in otitic complications, such as meningitis, sinus thrombosis and abscess of the brain. Prophylactically we use it also in the so-called protective or sympathetic forms of meningitis associated with mastoiditis and its complications. Because of its tendency to obscure the clinical course of the infection, our point of view at present is that sulfanilamide should be used cautiously if at all in acute otitis media. It is contraindicated during the course of suspected mastoiditis before operation and also after operation unless a diagnosis of one of the complications mentioned has been made.

To be more specific, we feel that for the present, at least, the indications for this form of chemotherapy from our experience are as follows:

Sulfanilamide may be given in otitis media before suppuration has taken place. We have not had sufficient experience in its use in this stage but pediatricists report favorable results. We know, however, that otitis media of this type commonly proceeds to spontaneous resolution.

Occasionally, in cases of extreme bacterial meningitis (streptococcal or pneumococcal), intensive administration is indicated before operation (twenty-four to thirty-six hours) and then postoperatively.

In sympathetic meningitis secondary to an extradural abscess, an abscess of the brain or labyrinthitis, sulfanilamide should be given. Removal of the otitic focus is imperative.

In thrombosis of the lateral sinus, as soon as the diagnosis has been established, administration of sulfanilamide should be instituted, followed by thorough operative intervention. It should be continued during the postoperative period. The drug is especially useful in instances of continued otitic sepsis, even though a thorough operative procedure has been previously performed. In such conditions phlebitis of various venous radicles tributary to the lateral sinus and inaccessible to surgical intervention may be responsible for the continuation of the sepsis.

In petrositis sulfanilamide should not be administered during the period of observation because of the danger of masking the clinical course and thus interfering with the proper management of the condition. Should operation be indicated, it is advisable to give sulfanilamide promptly in the usual manner.

That the indiscriminate use of sulfanilamide may result in latent forms of infection of the middle ear or the mastoid and their complications has been mentioned but scantily in the literature. The important

fact that sulfanilamide tends to mask the clinical picture of otitic infection has been observed sufficiently often to warrant drawing attention to it. A striking example of latency due to the administration of sulfanilamide was recently reported by Smith and Coon,² who stated that it is possible that a moderate dose of sulfanilamide will partially control meningitis so that it will present an unfamiliar clinical picture. During the course of acute suppuration of the middle ear their patient, a 6 year old child, had been receiving moderate doses of sulfanilamide. Following a mastoidectomy a clinical picture of sepsis presented itself, i e., the patient had a spiking temperature between 100 and 104 F, for which no other cause could be assigned, despite negative blood culture. A Tobey-Ayer test was done to confirm a strong suspicion of the presence of thrombosis of the lateral sinus, but to the astonishment of those present the spinal fluid was cloudy, showed a high cell count and on culture yielded *Streptococcus haemolyticus*. The patient had been euphoric and symptom free throughout. The mastoidectomy was revised, and intensive sulfanilamide therapy was then given, followed by recovery.

Relative to the masking of the clinical course resulting from the administration of sulfanilamide is the following note, appended to an interesting article by Ballenger, Elder, McDonald and Coleman.³

NOTE—Since this paper was read, confirmation of our conclusions has been offered by J S Lockwood (Observations on the Mode of Action of Sulfanilamide and Its Application to Surgical Infections, *Ann Surg* 108 801-812 [Nov] 1938). Lockwood showed that even a small amount of peptone or of peptone-like products greatly retards the germicidal activity of sulfanilamide. As far back as 1911 Bambridge had shown that some species of bacteria are unable to break down the protein molecule to obtain essential nitrogen. In consequence they starve to death in serum protein or egg albumin unless predigested protein in the form of peptone is supplied. Lockwood asserted that pus and tissue undergoing necrosis contain peptone-like products which prevent sulfanilamide from acting on the micro-organisms with the maximal effect that characterizes its effect on diffuse nonsuppurative infections. In a later paper (Studies on the Mechanism of the Action of Sulfanilamide, *J A M A* 111 2259 [Dec 17] 1938) Lockwood and his associates stated that relapses "were frequent in patients with localized infections containing necrotic tissue, such as mastoiditis and abscesses, whereas in bacteremia and erysipelas they were not encountered." They asserted that "the presence of debris, human or bacterial, diminished the effectiveness of sulfanilamide on the hemolytic streptococcus."

2 Smith, H B, and Coon, E H. Meningitis Due to a Hemolytic Streptococcus. Report of Two Cases with Recovery After Use of Prontosil and Sulfanilamide, *Arch Otolaryng* 26 56 (July) 1937.

3 Ballenger, E G, Elder, O F, McDonald, H P, and Coleman, R C. Failures in the Treatment of Urinary Tract Infections with Sulfanilamide, *J A M A* 112 1569 (April 22) 1939.

Otologists for a long time have been familiar with the clinical course of otitic infection due to *Pneumococcus* type III. The characteristic insidious clinical picture which an infection with this organism produces is almost identical with that resulting in some cases from the use of sulfanilamide during acute otitis media. There is the same freedom from pain, tenderness over the mastoid, which may be present at first, soon lessens or disappears, there may be apparent improvement of the infection in the middle ear, indicated by diminution or absence of discharge, but on further examination one notes the appearance of an unresolved infection, i. e., a thickened drum with absence of landmarks. Resolution may be much delayed, or a recurrence of signs of infection of the middle ear, with evidence of involvement of the mastoid or an otitic complication, may rather abruptly follow a longer or shorter period of latency. Otitic complications run an asymptomatic or atypical course, as pointed out in a number of cases which we have reported.

We suggest to those who are of the opinion that sulfanilamide should be given from the very beginning of otitis media that the patients be carefully observed over an extended period, despite apparent improvement in the otic picture and absence of symptoms, furthermore, as a therapeutic test, we advise the discontinuance of the drug for a few days during the period of observation to note whether a recrudescence of signs or symptoms of postauricular infection occurs. We have made the latter observation in a number of instances in which the drug had been given for a considerable time.

The reports of cases 1 to 6 and case 15, with the comments, illustrate the various phases of the masking effect of sulfanilamide observed in some cases of otogenous infection.

The administration of sulfanilamide has varied greatly from the time of its early use to the present. As the newer knowledge of its action, toxicity and therapeutic effect has come to light, modifications of the usual clinical pictures have been observed. Early in its use small doses were administered at irregular intervals and then withdrawn with the onset of cyanosis. With the knowledge that oxygen capacity, carrying power and saturation were but little affected, larger doses were given. Bigler, Clifton and Werner⁴ administered the drug by mouth on the basis of 15 grains (1 Gm.) to 20 pounds (9 Kg.) of body weight irrespective of age, sex or color. Long and Bliss⁵ gave an initial dose of fourteen to sixteen 5 grain (0.32 Gm.) tablets of sulfanilamide with the intention of obtaining a concentration in the blood

4 Bigler, J. A., Clifton, W. M., and Werner, M. The Leukocyte Response to Sulfanilamide Therapy, *J. A. M. A.* **110** 343 (Jan. 29) 1938.

5 Long, P. H., and Bliss, E. A. Para-Aminobenzenesulfonamide and Its Derivatives. Clinical Observations on Their Use in the Treatment of Infections Due to Beta Hemolytic Streptococci, *Arch. Surg.* **34** 351 (Feb.) 1937.

of 10 mg per hundred cubic centimeters within four hours in patients weighing 100 pounds (45 Kg) To maintain this level three 5 grain (0.32 Gm) tablets were administered every four hours For patients weighing 50 to 90 pounds (23 to 41 Kg) an initial dose of six to ten 5 grain (0.32 Gm) tablets was given, followed by a maintenance dose of two to three 5 grain (0.32 Gm) tablets every four hours The same authors suggested for hypodermoclysis in adults, an initial dose of 500 cc of an 0.8 per cent to 1 per cent solution, followed by 300 cc of the same solution at eight hour intervals

The method of administration that we have adopted is similar to that of Long and Bliss Since the drug is apparently completely absorbed from the gastrointestinal tract in four hours, the four hour maintenance dose was selected It is our aim for all severely toxic patients to attain a concentration in the blood of 10 to 15 mg per hundred cubic centimeters as rapidly as possible In an effort to do this, all available routes of administration are attempted, according to the patient's ability to take the drug by mouth When this is impossible, hypodermoclysis and intravenous and intramuscular routes are employed Intrathecal administration was soon discontinued because of the marked cytologic change caused by the drug, with elevation of temperature Also it was noted by Marshall⁶ that the concentration in the cerebrospinal fluid is close to the concentration in the blood and intrathecal administration is of no advantage Since forty-eight hours was required for the beginning of a therapeutic effect, our greatest dose is given early, with a maintenance dose that depends on the concentration in the blood Since, as has been shown, the latter varies directly with urinary output, an attempt to limit fluids during the first twenty-four hours tends to earlier attainment of a higher concentration

Because of the rapid loss by excretion of the drug, it is our policy to continue its administration day and night at regular three or four hour intervals, thus assuring maintenance of the level in the blood

It is our experience that not all patients of the same weight respond similarly to identical dosage We therefore vary our dosage with different patients according to the concentration attained in the blood

Our dosages are modified considerably by the severity and toxicity of the patient's condition Ottenberg⁷ stated that in overwhelming infections one should disregard the possible toxic systemic effects of the drug in an attempt to overcome the infection as early as possible As will be pointed out, the progressive fall in hemoglobin witnessed during the administration is controlled by small repeated transfusions

6 Marshall, E. K., Jr. The Determination of Sulfanilamide in the Blood and the Urine, *Proc Soc Exper Biol & Med.* **36** 422 (April) 1937

7 Ottenberg, R. Treatment of Hemolytic Streptococcus Infections and Newer Applications of Sulphanilamide, *Bull New York Acad Med* **14** 453 (Aug) 1938

Marshall⁶ showed that sulfanilamide is almost equally distributed in all tissues of the body, excluding fat and bone. It is the latter finding that makes it imperative for sulfanilamide to be used only after the suppurative focus in the bone has been eradicated.

When severe infections appear to be overcome, it is a natural tendency to reduce the intake of a potentially toxic drug like sulfanilamide. In a number of our cases premature discontinuance of the drug was followed shortly by exacerbation of the symptoms previously mentioned. Administration of the drug was again influential in clearing the infection. Gradual reduction of the intake is advisable and should depend on the clinical course and the progress of the patient unless, of course, signs of acute intoxication supervene.

It has been our experience with the use of proprietary preparations like neoprontosil that the exact calibration of the drug is more difficult than with sulfanilamide itself. The complicating factor of the azo dye confuses the known indexes for its use. Since it is probable that the aforementioned drug acts by a reduction to sulfanilamide and that in the prontosil molecule sulfanilamide is the effective radical for treatment of infections, sulfanilamide is the drug of choice.

When the clinical indications existed, we have supplemented sulfanilamide therapy with small repeated blood transfusions to combat the hemolytic effect of the drug. Occasionally, specific antisera have been used, but they were given empirically in streptococcal infections and without controls.

Basman and Perley⁸ suggested supportive treatment with isotonic sodium lactate or lactate-Ringer solution and dextrose to combat acidosis and dehydration.

Daily, and sometimes more frequent, lumbar punctures are done both for relief of intracranial hypertension and for drainage. There is apparently no more advantage in continued drainage than in frequent lumbar taps.

During the past few months numerous encouraging reports have appeared in the British medical journals, especially the *Lancet*, on the treatment of severe, fulminating pneumococcal meningitis of otitic and other origin. The drug used, sulfapyridine, is variously referred to (for instance, as M & B 693 and daganan) and is essentially sulfanilamide with a pyridine substitution factor. It is said to be more effective than the original preparation, sulfanilamide, against both streptococcal and pneumococcal infections. As yet, our experience with the drug does not warrant commitment, but the reports of its use are highly favorable. The toxicity of the drug is said by various observers to be less than that of sulfanilamide.

⁸ Basman, J., and Perley, A. M. Report of Patients Treated with Sulfanilamide at St. Louis Children's Hospital, *J. Pediat.* **11**: 212 (Aug.) 1937.

REPORT OF CASES

The following cases are reported with comments to illustrate many of the points discussed

CASE 1—D Y gave a history of pain in the left ear, followed one week later by myringotomy with *Str haemolyticus* obtained from the ear. A thin pulsating discharge continued for the next three weeks. Hearing was impaired, the nasal sinuses were clear. The patient was given 10 grams (0.6 Gm) of sulfanilamide every four hours. Twenty-two days after the onset of infection, nystagmus to the right and left developed, more marked to the left. This continued unabated, associated with supraorbital headache. The middle ear showed evidence of resolution up to the day before operation, when the ear drum became full and the middle ear began to discharge. On pressure over the mastoid, the patient complained of slight soreness but no actual pain. The administration of sulfanilamide was stopped.

Mastoidectomy was performed on the left, and marked destruction of the mastoid was observed, the dura was covered with fine granulations. The possibility of petrositis was considered because of the nocturnal pain, slight postauricular tenderness, thick discharge, subfebrile course and nystagmus directed to the diseased ear. The patient is now apparently on her way to recovery.

Comment—The clinical picture was masked by sulfanilamide, which produced a low temperature, absence of pain and evidence of resolution of the infection in the middle ear without signs of involvement of the mastoid. Petrositis was the first indication of an otitic complication, without apparent postauricular disease.

A great deal more pathologic change in the mastoid was found than was clinically suspected.

In the early stages, postauricular tenderness was marked. Following the administration of sulfanilamide, the tenderness was definitely absent, although there were evidences of petrositis.

CASE 2—In T A, a 10 year old girl who had scarlet fever, acute otitis media developed, for which myringotomy was performed. The ear drained continuously and profusely. The area over the mastoid was not tender. The patient had been given sulfanilamide for thirty days, about 20 to 30 grams (1.3 to 1.9 Gm) per day, with no cessation of the aural discharge. For one month there was no headache or postauricular pain.

When first seen, the child had a temperature of 99.5 F and was comfortable. Vague temporal headache had occurred one day before. There were slight postauricular tenderness and a profuse discharge. The administration of sulfanilamide was stopped, and the next day the temperature rose to 102 F. The child became restless, and headache became marked. Postauricular tenderness was definitely increased.

Simple mastoidectomy revealed extensive disease everywhere in the mastoid, with complete destruction of the zygoma and the tip. Culture of material removed at operation revealed *Str haemolyticus beta*.

Comment—Sulfanilamide was given early in acute otitis media.

Definite progression to coalescent mastoiditis occurred despite the drug.

Headache, fever and other clinical evidence were absent, despite marked destruction of the mastoid

Twenty-four hours after the discontinuance of sulfanilamide, fever, headache and postauricular tenderness appeared, when the masking effect of the drug was removed

The ineffectuality of the drug in the presence of a suppurative focus and its capacity to attenuate the course of disease without preventing its progression were demonstrated

CASE 3—I C, a 5 year old white boy, had pain in the left ear two days before admission to the hospital, following cough and fever for ten days. Examination revealed an acutely ill child. The right ear drum was normal, the left was full, red and covered with hemorrhagic blebs and a thin pulsating discharge. Signs of bronchopneumonia were present. The child was given sulfanilamide with the onset of otitis.

Two days after admission, the temperature rose to 105 F, the child became irritable, and there were meager clinical signs suggestive of meningeal irritation. Lumbar puncture showed an increase of pressure, with cloudy fluid containing 230 cells per cubic centimeter, with 92 per cent polymorphonuclear cells. Subsequently the fluid was reported to contain *Str. haemolyticus* beta, as did the culture of material from the middle ear. A blood culture was sterile.

The child was given sulfanilamide at four hour intervals day and night, 120 grains (7.8 Gm) were given the first twenty-four hours and the dose then reduced to 90 grains (5.8 Gm) per day. The concentration in the blood was kept at 8 to 10 mg per hundred cubic centimeters. The fever precipitously subsided, and the child was comfortable during the next ten days, despite the persistence of meningitis, indicated only by examination of the spinal fluid. Within forty-eight hours after the administration of larger doses of sulfanilamide (90 grains [5.8 Gm] daily), all clinical evidence of meningitis disappeared except for the findings in the spinal fluid. The high cell count continued for a few days, and the polymorphonuclears, which had increased, were soon replaced by lymphocytes, until, on the day before the mastoidectomy, the spinal fluid showed a count of 12 lymphocytes. Culture of the spinal fluid revealed *Str. haemolyticus* on only one occasion. A few days later, however, slight but increasing postauricular tenderness was noted, with persistence of moderate aural discharge.

Twelve days after admission and ten days after the onset of meningitis, simple mastoidectomy was performed. Complete destruction of the mastoid without involvement of the dura or lateral sinus was found.

Comment—Meningitis occurring two days after the onset of acute otitis media was clinically controlled by massive doses of sulfanilamide, the child remained comfortable and playful, with a temperature of 100 to 100.5 F, despite meningitic activity, indicated only by lumbar puncture.

Our clinical concept of mastoiditis was definitely altered by sulfanilamide.

CASE 4—R R, aged 25, had had acute infection of the upper part of the respiratory tract six days before her admission to the hospital. On the morning of admission she complained of severe pain in the left ear and supraorbital headache on the left.

Examination revealed acute otitis media, with all landmarks missing. The hearing was impaired. Myringotomy was performed with the patient under general anesthesia, thick pus was obtained under pressure, which subsequently yielded a culture of *Str. haemolyticus*. After myringotomy, the ear continued to discharge a thick purulent secretion, and tenderness over the left mastoid developed on the fourth day. The patient was then given sulfanilamide, 90 grains (5.8 Gm.), each day for six days. During this period the discharge diminished greatly, the drum remained full, and tenderness over the mastoid was still present but was diminished. On the fifteenth day of the otitic history, the patient complained of pain behind the left eye. There were a few nystagmoid jerks when she looked to the right, the hearing was impaired to perception of a loud whisper, the patient complained of a loud, annoying thumping in her ear. The fundus of the ear revealed a full, pulsating drum, without discharge, visible landmarks, or changes in the walls of the canals. There was slight tenderness over the mastoid and the emissary vein. Administration of sulfanilamide was stopped.

The patient remained in the hospital for three and one-half weeks. There was a picture of delayed resolution of the infection in the middle ear. Just before her discharge from the hospital, i. e., on the twenty-third day of the otitic history, the drum still remained full, and only a short process was visible.

The patient was observed closely after her discharge from the hospital, up to the sixth week of the otitis, when there was evidence of the beginning of resolution of the infection in the middle ear.

Comment—This is a case of acute otitis media in which sulfanilamide had been given. The subsequent clinical picture became exceedingly bizarre, symptoms were masked, and the infection in the middle ear remained unresolved for six weeks. For a considerable period it was difficult to state whether we were dealing with a latent mastoiditis or an unusual form of otitis media.

CASE 5—C. L., a 63 year old woman with diabetes, was admitted to the hospital with a ten day history of discharge from the ear following infection of the upper part of the respiratory tract. Culture of material from the ear showed *Pneumococcus* type III. Simple mastoidectomy, performed three weeks after the onset, revealed multiple abscesses everywhere in the mastoid. The sinus was yellowish white, contained thick pus and was obliterated by an obturating thrombus. Further procedure was not carried out, because of the patient's condition. Postoperatively her diabetic condition was always under control. Sulfanilamide was given intravenously and by mouth. For three weeks after the operation, her condition was subfebrile, and then a sudden chill developed, with a rise of temperature to 104 F. At this time the internal jugular vein was ligated. The patient died two days afterward, having had preagonal alternating jacksonian tremors. Blood culture at this time showed *Pneumococcus* type III. Postmortem examination showed extension of an obturating thrombus to the torcular Herophili, into the superior longitudinal sinus and over to the opposite lateral sinus and jugular bulb.

Comment—Thrombosis of the lateral sinus was due to *Pneumococcus* type III.

The postoperative course may have been altered by sulfanilamide.

This form of medication should not be given postoperatively unless the sinus has been thoroughly obliterated. There is a risk of masking

the true clinical picture while progressive extension of the thrombophlebitis takes place

CASE 6—J L, a woman 22 years of age, had an infection of the upper part of the respiratory tract two weeks before her admission to the hospital. Four days before admission pain in the left ear developed, followed by myringotomy one day later. For two days before admission she had been dizzy, the type of vertigo was not carefully described. The temperature ranged between 100 and 102 F, she did not have chills or convulsions, but she did have marked parietal headache.

Ten days after admission signs of acute mastoiditis developed, and simple mastoidectomy was done on the left, with the patient under general anesthesia. The mastoid was large, with no destruction of the intercellular septums. Each cell contained thin pus, from which *Str. haemolyticus* beta was subsequently cultured. After operation the patient had sustained febrile reaction, which could not be accounted for by a local aural condition. Fifteen days after operation she began to complain of pain over the left eye, and at this time the possibility of suppuration of the petrous pyramid was thought of. Examination of the nose and paranasal sinuses did not reveal anything at this time. Twenty days after the original mastoidectomy, the wound was revised, and the petrous pyramid was investigated. Granulations were removed from the plate of the sinus and that of the middle fossa. No tract was visible in or around the semicircular canal. The squama was removed and the dura of the middle fossa elevated from the superior surface of the petrous pyramid. This was done with ease, because a large amount of fluid was removed by spinal tap prior to operation. A large gush of nonodorous thick creamy pus was obtained from a pit about $\frac{1}{2}$ inch (1.3 cm) anterior to the arcuate eminence. A rubber drain was inserted and the wound closed. Culture of the pus showed *Str. haemolyticus*. The patient received repeated transfusions. Lumbar puncture, performed five days later because of headache and some rigidity of the neck, revealed evidence of meningitis, with fluid containing 4,500 cells, 80 per cent polymorphonuclears and 20 per cent lymphocytes, and yielding no organisms on smear. At this time, one month after the original mastoidectomy, the possibility of an abscess of the brain was considered, but no localizing signs were found. Repeated spinal taps were done. The patient was given large doses of sulfanilamide, the hemoglobin watched and the sulfanilamide content of the blood and spinal fluid determined at regular intervals.

About forty days after the original operation it was first noticed that anomia and a few vague changes in the deep and superficial reflexes had developed. Blood cultures were repeatedly negative. At this time an abscess of the brain, loculated meningitis and otitic hydrocephalus were all considered, but no definite diagnosis could be made. Because of the persistence of the findings in the spinal fluid, the wound was reinvestigated. The dura was seen to be covered by a thick yellow exudate, and on elevation of the dura of the middle fossa again a gush of thick creamy pus appeared. Loculated pockets were not found. Because of the persistence of fever and of the findings in the spinal fluid, repeated attacks of vomiting and transient anomia, eight days after the reexploration of the petrous pyramid an exploratory craniotomy for an abscess of the left temporal lobe of the brain was performed. Aspiration in several directions in the temporal lobe failed to show any pus. The dura was incised, and it was noted that the brain had a peculiar yellow discoloration, but no pus was found. After the craniotomy the patient's condition was about the same until dressing was done ten days later and the probe fell into a cavity in the temporal lobe. A few ounces of thick

pus escaped. After drainage of this abscess cavity, the patient's condition progressively improved, the neurologic symptoms gradually subsided, and except for the peculiar mental changes, the patient appeared to be getting well. Gradually thereafter, the spinal fluid became clear, the mental state returned to normal, the temperature became normal, and the patient progressed to an uneventful recovery with no sequelae other than some diminution of hearing.

Comment—The patient had acute mastoiditis complicated by suppurative petrositis, streptococcal meningitis and an abscess of the temporal lobe.

The clinical picture of otitic meningitis was masked by the use of sulfanilamide. On a number of occasions except for a moderate fever the patient was symptom free. Physical signs were absent, and yet spinal tap gave definite evidence of meningitis, i. e., an increase in cells and streptococci.

Until the otitic focus was adequately dealt with, sulfanilamide only partially controlled the meningitis.

The course (two and one-half months) of meningitis was prolonged under administration of sulfanilamide.

CASE 7—B. R., a German emigrée, came to America eight days prior to her admission to the hospital. She was perfectly well up to three days before admission, when pain in the right ear developed. Myringotomy was done on the day before admission, with discharge of pus.

The patient was acutely ill and complained of occipital and frontal headaches. Examination of the ear showed a seropurulent nonpulsating discharge on the right side. The hearing was poor. Evidence of mastoiditis was not present. The nose showed some mucopus and crusts on both sides. The mucosa was acutely inflamed. Smears from the sphenoid sinus at this time showed some pus cells and some gram-positive diplococci. The patient had moderate stiffness of the neck, a positive Kernig sign and absence of the abdominal reflexes. There was suggestive paralysis (lower) of the right facial nerve.

Spinal tap on admission showed the fluid with a ground glass appearance, under increased pressure. There were 1,800 cells per cubic centimeter with 94 per cent polymorphonuclears. Organisms were not seen on smear. The blood count was 10,000 cells per cubic centimeter, with 84 per cent polymorphonuclears. A culture of the first spinal fluid was negative. The patient was given anti-meningococcus serum intraspinally. Sulfanilamide therapy was begun immediately. Spinal tap done the next day showed 1,200 cells, with 90 per cent polymorphonuclears. Culture of the spinal fluid contained *Str. haemolyticus* beta.

Examination of the ear at this time showed a thick purulent pulsating discharge from the middle ear, with the peripheral paralysis of the facial nerve still moderately well marked. At this time, however, there was a large central perforation of the drum, which had not been seen, or was not present, before. It was difficult, therefore, to decide whether the patient had had chronic otitis with an old perforation or whether the picture was that of acute massive destruction of the drum. Another spinal tap, done four days after admission, showed the fluid to contain *Str. haemolyticus* beta. Because of the paralysis of the facial nerve and the picture in the middle ear, we were inclined to believe at this time that the mastoid was the seat of the primary focus. Operation, however, was not

performed For three or four days, the patient was treated with neoprontosil⁹ and sulfanilamide in massive doses The cell count of the spinal fluid became progressively less, with diminution of the number of polymorphonuclears and an increase in the number of lymphocytes The culture of the spinal fluid, which on three occasions had contained *Str haemolyticus beta*, was now negative

Eight days after admission, a marked urticarial eruption developed, probably due to the serum Slowly but progressively the paralysis of the facial nerve became less marked, the spinal fluid became clearer throughout the patient's stay, and the results of examination of the nose and throat were considered entirely negative The condition improved markedly, the discharge from the ear became scant, the perforation became smaller, finally, spinal tap showed a normal chemical and cytologic picture and no growth

The patient was in the hospital for eight weeks before she was discharged as cured

SULFANILAMIDE THERAPY

3/27 to 3/28	40 cc of neoprontosil (given intramuscularly)
	300 cc of 0.8 per cent solution of sulfanilamide (given subcutaneously)
3/28 to 3/29	80 cc of neoprontosil (given intramuscularly)
3/29 to 3/30	60 cc of neoprontosil (given intramuscularly)
	50 grains (3.2 Gm) of sulfanilamide
3/30 to 3/31	50 grains (3.2 Gm) of sulfanilamide
3/31 to 4/1	60 cc of neoprontosil (given intramuscularly)
4/1 to 4/2	20 grains (1.3 Gm) of sulfanilamide
4/2 to 4/3	50 grains (3.2 Gm) of sulfanilamide
4/3	40 grains (2.6 Gm) of sulfanilamide
4/4	40 grains (2.6 Gm) of sulfanilamide
4/5	40 grains (2.6 Gm) of sulfanilamide
4/6	20 grains (1.3 Gm) of sulfanilamide
4/10	20 grains (1.3 Gm) of sulfanilamide

Comment—Otogenuous streptococcic meningitis developed three days from the onset of otitis media

The patient recovered, without operative intervention, with the use of sulfanilamide over a long period

The importance of a knowledge of the pathway of invasion of the meninges is illustrated

CASE 8—P. K., a 13 year old girl, was admitted to the otologic service of the Mount Sinai Hospital with a history of infection of the upper part of the respiratory tract followed by pain in the right ear, for which myringotomy had been performed three weeks previously On admission, the child was acutely ill, somnolent but responsive

Findings of interest were essentially limited to the ears The right ear showed a pulsating, purulent discharge, which reappeared after it was wiped away The duration of the discharge, as stated was three weeks There was slight but definite tenderness over the antrum of the mastoid, with no definite changes in the walls of the canals There was slight weakness of the external rectus muscle on the right Examination of the nose showed a small amount of mucopurulent

⁹ The disodium salt of 4-sulfamidophenyl-2'-azo-7'-acetyl amino-1'-hydroxy-naphthalene-3',6'-disulfonic acid This is the substance previously known as prontosil soluble and as prontosil

secretion but no pus in the sphenothmoid recess. The pharynx was granular and injected. The left ear was normal. The neck was definitely rigid. The deep reflexes were depressed. The corneal reflex was not diminished. The pupils reacted well. There was slight blurring of the nasal margin of both disks in the fundus. An addendum to the history stated that the child was suddenly unable to hear a few days before admission. Examination with the Barany noise apparatus seemed to show that no hearing was present in the right ear, there was, however, prompt vestibular response on caloric examination.

A spinal tap done on admission showed the fluid to be turbid, under an initial pressure of 360 mm, with 7,200 cells, 90 per cent of which were poly-

Administration of Sulfanilamide in Case 8 (P. K.)

Day	Hemoglobin %	Cell Count of the Cerebro-spinal Fluid	Sulfanilamide Administered			Concentration in the Blood	Concentration in the Cerebro-spinal Fluid	Concentration in the Urine	Transfusions	Culture
			Per Os, Grains	Intravenously Gm	Total Grains					
1		7,200								Positive
2 (Operation)		4,200	30	4.8	104					Positive
3		750	85		85				500	Negative
4	60	1,200	50		50	6.7		190		Negative
5			50		50					Negative
6	71	420	60		60	9.5	7.7	215		Negative
7		380	50		50					Negative
8	70	300	50		50	6.7	Trace	200	500	Negative
9		800	57		57					Negative
10		180	45		45	4.5		113		Positive
11		2,800	52		52					Negative
12		1,400	90	2.4	127					Positive
13	64	1,600	140	2.4	177				400	Negative
14	65	6,000	170	2.4	207	6.3	5.0			Positive
15	55	1,500	200		200	8.7	6.9	116	500	Positive
16	65	4,000	200		200	10.5	8.0		300	Positive
17	69	4,600	250		250	9.7	11.1	157		Positive
18	69	2,750	280		280	12.0	11.5	250		Positive
19		2,500	280		280	13.3	13.3			Positive
20	68	2,400	280		280	13.3				Negative
21	59	650	280		280	9.1			400	Negative
22	68	260	280		280					Negative
23	72	100	265		265					Negative
24	79	50	215		215					Negative
25*	80	none	200		200					Negative

* From the twenty-fifth day of illness to the patient's discharge, on the fortieth day, the dosage of sulfanilamide was diminished to 22½ grains per day, and then it was stopped, as the clinical picture improved.

morphonuclears. No organisms were seen on smear. The Wassermann and Kahn reactions were negative. The impression on admission was that the child had meningitis of otitic origin. With the patient under anesthesia induced by avertin with amylene hydrate, nitrogen monoxide and ether, a simple mastoidectomy was performed. The mastoid seemed moderately sclerotic and filled with diploic bone. No frank pus was visible, but a tremendous amount of softening was found in the initial groove, especially behind the sinus. The squama was removed, exposing the dura of the middle fossa.

Massive doses of sulfanilamide were immediately prescribed, and the child was given repeated transfusions. The spinal fluid contained *Str. haemolyticus* on admission and on twenty subsequent occasions. The child made a slow but progressive recovery. Nuchal rigidity persisted for a long time after the spinal fluid ceased to show any organism. There was a persistently subfebrile course,

which could not be accounted for by any suppurative focus. In view of this, it was felt that sulfanilamide might be responsible, and when its administration was discontinued, the fever immediately subsided and the temperature stayed down. At the time of the patient's discharge there was no evidence of any residua except slight facial asymmetry and barely perceptible weakness of the right external rectus muscle.

Comment—Neoprontosil⁹ had been administered at the onset of the illness.

The interesting gross findings in the mastoid at operation were probably influenced by the use of sulfanilamide.

Control of meningitis by means of massive doses followed a flare-up during the administration of small doses.

The persistent subfebrile course after apparent recovery from meningitis was unaccounted for by the suppurative focus and promptly controlled by the discontinuance of sulfanilamide therapy.

CASE 9—In E. G., a 6½ year old boy, following an infection of the upper part of the respiratory tract nineteen days before his admission to the hospital, measles developed. The course was uneventful until ten or eleven days before admission, at which time he complained of pain in the ears. Myringotomy, five or six days later, was followed by a discharge from the ears. Chills or convulsions were not present. At 3 a. m. on the day of admission the child became drowsy and vomited. Drowsiness progressed during the day. The temperature had been 100 to 104 F. during the past week. A cough was not present.

Examination on admission revealed an acutely ill, dehydrated, semistuporous child, in a toxic condition. The pharynx and nose were congested but otherwise did not yield significant observations. The right ear drum was full, landmarks were not visible. There was a small amount of discharge from an anterior perforation, which did not quickly reappear. Tenderness over the mastoid was not present. In the left ear, the drum was full, landmarks were not present, there was an active pulsating discharge from an anterior perforation, and definite tenderness over the mastoid was noted. The heart and lungs were essentially normal, without murmurs. There was slight impairment of response to percussion over the bases of both lungs, suggestive of early bronchopneumonia. Examination of the abdomen revealed that the spleen was not palpable. Neurologic examination showed rigidity of the neck, positive Kernig and Brudzinski signs and depressed reflexes. Examination of the eyes disclosed good extraocular motion, without paralysis, that of the eyegrounds showed congested vessels, without papilledema.

The impression on admission was that the child had meningitis of otitic origin. Culture of material from the ear, blood culture, lumbar puncture and roentgenograms of the mastoids and of the lungs for bronchopneumonia were advised.

Lumbar puncture on admission yielded a fluid containing 2,600 cells, with 78 per cent polymorphonuclears and 22 per cent monocytes. A centrifuged specimen showed no organisms on smear. Roentgen examination showed an infantile mastoid with two or three large cells, without marked destruction. The pulmonary fields showed infiltration of the bases of the lungs. The leukocyte count was 13,300 cells, with 73 per cent polymorphonuclears, 18 per cent of which were nonsegmented, 25 per cent lymphocytes and 2 per cent monocytes. The hemoglobin

content was 78 per cent, Wassermann and Kahn reactions were negative and the urine normal

The child was immediately given a transfusion of 500 cc of citrated blood, without immediate reaction

Bilateral mastoidectomy was performed, with the patient under anesthesia induced by avertin with amylene hydrate and nitrogen monoxide in routine fashion. On the right side, frank pus on removal of the cortex and a moderate amount of periantral sclerosis were found. On removal of the dural plate an epidural abscess was uncapped. No perisinus abscess was observed. A large gush of pus in the region of the zygoma, probably due to a broken-down gland, was seen. The bone was diploic, with three large cells. On the left side, frank pus was found on removal of the cortex. Little cellular structure was noted. No epidural or perisinus abscess was observed. Prior to operation 15 cc of spinal fluid had been withdrawn. A continuous intravenous infusion of physiologic solution of sodium chloride ran slowly throughout the procedure. Culture of material from each mastoid yielded *Str. haemolyticus*.

The child was given massive doses of sulfanilamide, repeated lumbar punctures and repeated small transfusions. Despite intense "cyanosis," administration of sulfanilamide was continued. The child made slow but progressive improvement, and after almost two months made an uneventful recovery.

Comment—Massive doses of sulfanilamide were given as a preliminary measure for thirty-six hours, because the patient was too ill from otitic meningitis to withstand bilateral mastoidectomy.

Prompt recovery followed mastoidectomy, after prolonged use of smaller doses of sulfanilamide.

Mild acute hemolytic anemia was easily controlled by the proper measures.

CASE 10—J. R., a 16 year old boy, was admitted to the hospital with a history of having had chronic purulent otitis media on the left for thirteen years. Ten days before admission the patient had an acute exacerbation and two days before admission a temperature of 104 F, with a chill. Blood culture on admission showed *Str. haemolyticus*. A mastoid was found to be completely destroyed and the wall of the sinus diseased. The lateral sinus was obliterated and the internal jugular vein tied off. Thrombus was not demonstrable. Administration of sulfanilamide, 30 grains (19 Gm) every three hours, was started on admission, after the blood culture was taken, and continued postoperatively. The temperature rose on three occasions to 103 F and then fell to normal within twelve days and stayed so until discharge.

Comment—Sinus phlebitis occurred in acute exacerbation of a chronic condition of the ear.

Sulfanilamide was given in massive doses after a blood culture was taken and operation decided on.

CASE 11—G. B., a 4 year old boy, had a discharge from the ear for three months. Three days before his admission to the hospital he began to vomit, and one day before admission he had a marked swelling behind the ear. On admission there was a foul-smelling discharge through an anterior perforation in the left drum, with marked postaural tenderness and swelling, drowsiness, paralysis of the

left facial nerve, stiffness of the neck and definite evidence of meningitis. Spinal tap showed 13,000 white blood cells, culture showed *Bacillus coli*. Blood culture showed a minute *Str. haemolyticus* of Long. Simple mastoidectomy was done, and complete necrosis of the entire mastoid was observed, with the dura covered by greenish yellow exudate, which extended over the entire middle and posterior fossae, and cholesteatoma in the epitympanum. The child was given large doses of sulfanilamide and transfusions but died within two days after operation, of meningitis.

Comment—*B. coli* and *Str. haemolyticus* (minute) of Long were cultured.

The child had been given a "new medicine," in all probability sulfanilamide, for many weeks after the onset of the discharge from the ear.

CASE 12—D. B., a 5 year old child, was admitted to the hospital with a history of fever and headache for two weeks and a thin discharge from the left ear for eight days. Four days before his admission there was marked postaural swelling. On the day of admission, he had a chill and a rise of temperature to 104 F. He was toxic and dehydrated, evidence of bilateral pneumonia was noted, there was an icteric tint to the skin. The right ear drum was essentially normal, the left ear showed an active pulsating discharge and sagging of the wall of the canal. The hearing was impaired, and there was exquisite tenderness over the postauricular area. A blood culture taken on the day of admission was negative. Mastoidectomy was done on the left, with the patient under general anesthesia, and a completely necrotic mastoid was found. The lateral sinus and the dura appeared normal. The immediate postoperative course was eventful, with chills and elevation of temperature to 105 and 106 F. Three days after the simple mastoidectomy, a metastatic focus developed in the left hip, and it was decided to obliterate the left lateral sinus. This was done about two hours before the last blood culture was reported to contain *Str. haemolyticus*. The internal jugular vein was ligated at that time.

The child was immediately given large doses of sulfanilamide, receiving 20 grains (1.3 Gm.) every three hours day and night. When he was unable to take it by mouth the drug was given intravenously. There was a progressive fall in the hemoglobin content, which was bolstered by repeated small transfusions. Evidence of suppuration of the left hip then developed, and incision and drainage liberated a great deal of pus. The concentration of sulfanilamide in the blood was maintained at 10 mg. per hundred cubic centimeters. The child's general condition improved, and evidence of sepsis completely disappeared. The child one day complained of pain at the tip of his tongue, and a small ulceration appeared. A blood count showed a typical picture of agranulocytosis, with only 1,700 white blood cells, of which 2 per cent were polymorphonuclear leukocytes, 6 per cent eosinophils, 89 per cent lymphocytes and 3 per cent monocytes. Administration of sulfanilamide was immediately stopped, and the child was given repeated transfusions, with a prompt polymorphonuclear response. Aside from toxic hepatitis, which soon disappeared, the child went on to make a complete recovery.

Comment—This case is interesting because of the complication of agranulocytosis and the toxic hepatitis. Also, sulfanilamide was given only when the diagnosis had been made, and in no way were our clinical indications obscured.

CASE 13—R P, an 8 year old child, had had a discharge from both ears for two weeks and presented a history of chills and elevation of temperature to 106 F on two occasions. He was acutely ill, with a pulsating discharge from the right ear and a less marked one from the left. The eyegrounds showed slight blurring of the nasal side of the disks. Changes in the walls of the canals were not noted. Blood culture on admission showed *Str. haemolyticus*. Bilateral mastoidectomy was done, and complete destruction of the mastoid was found, with a few granulations on the left sigmoid sinus. Five days later, because of the persistence of septic fever, the left internal jugular vein was ligated and the sinus obliterated. A mural thrombus was found in the bulb. Blood culture again showed organisms before operation. The child was given repeated transfusions and large doses of sulfanilamide orally, intravenously and intramuscularly. The hemoglobin content progressively fell and was bolstered by transfusion. Fifteen days after the second operation the papilledema which was present before the obliteration of the sinus disappeared. The child made an uneventful recovery.

Comment—Sulfanilamide was given only after the diagnosis was established, and our clinical picture was not masked.

The hemoglobin content progressively fell with the administration of sulfanilamide.

CASE 14—A G, a 3 month old infant, had an infection of the upper part of the respiratory tract two weeks before his admission to the hospital, accompanied by discharge from the right ear. The discharge persisted to three days before admission. The day before admission he had swelling behind the right ear.

Examination revealed an acutely ill child. The auricle of the right ear stood away from the head, the canal was narrow and filled with pus. The drum was poorly visualized. Postauricular swelling and periosteal thickening were noted. The left ear was normal.

Simple mastoidectomy was performed on the right. A subperiosteal abscess was found, with multiple cortical perforations. The cavity of the mastoid was completely destroyed. The sinus and the dura were not exposed. Culture of the pus revealed *Pneumococcus* type V. On the day after the operation the temperature rose to 105 F, which was considered a reading to be expected postoperatively, but the fever persisted from then on, ranging between 101 and 105 F, with days of sustained fever. Three days after operation, the patient showed evidence of increased intracranial tension, i.e., bulging of the fontanel, stiffness of the neck and Brudzinski's and Kernig's signs, without nystagmus. The chest appeared clear clinically and roentgenologically. A lumbar puncture at that time showed cloudy fluid, with a 4 plus Pandy reaction, 1,260 cells, 90 per cent of which were polymorphonuclears, gram-positive cocci in chains and a negative reaction for sugar, according to Neufeld's typing, the spinal fluid contained *Pneumococcus* type V.

The child was given repeated lumbar punctures and $2\frac{1}{2}$ grains (0.16 Gm.) of sulfanilamide every four hours night and day for twenty-four hours. Sulfanilamide was given in increasing doses up to 30 grains (1.9 Gm.) per day. Blood culture four days postoperatively showed *Pneumococcus* type V. Anti-pneumococcus serum type V was given intrathecally on eight successive days, a total of 117,500 units.

Repeated lumbar punctures showed increased pressure and an increase in cells and organisms. Concentrations of sulfanilamide were raised to 10.5 mg per hundred cubic centimeters. There was a slight drop in temperature, but this

was transitory. The question of abscess of the brain arose, but neurosurgeons did not see any indications for an intracranial operation. A ventricular tap with injection of serum was ineffectual, and the child died twenty-five days after admission. Permission for autopsy was not obtained.

Comment—The course (25 days) of otitic meningitis due to Pneumococcus type V in a 3 month infant was much prolonged under treatment with sulfapyridine.

CASE 15—In B. B., a 7 year old child, influenzal otitis media developed during the course of an infection of the upper part of the respiratory tract. Two days later spontaneous rupture of the drum occurred. The temperature ranged between 100 and 101 F for a few days, and a thin discharge from the middle ear became profuse. Administration of sulfanilamide, 40 grains (2.6 Gm) daily, was begun one week from the onset of the otitis and continued for six days. The discharge from the middle ear soon stopped and the beginning of resolution was noted. The temperature returned to normal, and the general condition was excellent. It was decided to discontinue the administration of sulfanilamide because of knowledge of a possible masking effect of the drug. Thirty-six hours after the administration of sulfanilamide was stopped, the middle ear began to discharge profusely, the discharge was thicker than it had been at any time, and the drum had a "boggy" appearance. Tenderness over the mastoid increased, and the patient had spontaneous aural pain. The temperature ranged between 99 and 100 F. After forty-eight hours of observation during which the local manifestations increased in severity, it was decided that mastoidectomy was indicated. Operation disclosed free pus and granulations, with areas of softening throughout an unusually large mastoid. Hemolytic streptococci were cultured from pus from the mastoid.

Comment—A latent or quiescent period during the administration of the drug was shown. This case illustrates the importance of careful observation of patients who are given sulfanilamide during the course of otitis media and the diagnostic value of withdrawal of the drug, to determine whether apparent improvement is only a masking effect.

SUMMARY AND CONCLUSIONS

The use of sulfanilamide has resulted in a genuine advance in the treatment of certain otogenous infections.

Eradication of the otitic focus is of paramount importance.

Indiscriminate use of the drug may obscure the diagnosis or result in masked or latent involvement of the mastoid.

With sulfanilamide therapy, the usual clinical course of an otitic complication may be modified.

Massive doses in the earlier stages, controlled by determinations of the concentration in the blood, have given the best results.

Indications for administration are discussed, and illustrative cases are cited.

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ORIGIN OF THE QUICK COMPONENT OF LABYRINTHINE NYSTAGMUS

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The mechanism of one of the most striking clinical phenomena, the rhythmic ocular movements appearing on stimulation of the labyrinth, is still a controversial subject. For many years clinicians have tried to localize a "center" of the fast component of nystagmus. It is perhaps appropriate to state the problem in another way, that is to ask on the intactness of which parts of the central nervous system the genesis of rhythmic reaction of the ocular muscles to labyrinthine stimulation depends. The theories put forth in an attempt to answer this question may be divided as follows (Spiegel¹ and Spiegel and Sommer²)

I The cerebral theory, which attributes the function to the parts of the central nervous system above the midbrain

II Theories assuming that the origin of the rhythm is in parts of the vestibulo-ocular reflex arc

The various theories of group II may be enumerated as follows

1 The proprioceptor theory, which assumes that the rhythmic reaction is due to proprioceptive impulses from the ocular muscles

2 The ocular muscle nuclei theory, which locates the origin of the rhythm in the nuclei of the motor nerves to the ocular muscles. The assumption is that there is a mutual inhibition of the oculomotor nuclei

3 The labyrinthine theory, which seeks the origin of the rhythm in the labyrinth

4 The vestibular nuclei theory, which attempts to localize the origin of the rhythm in the vestibular nuclei

5 The reticulate substance theory, which localizes the origin of the rhythm in the substantia reticularis rhombencephali

The cerebral theory is refuted by the failure of the elimination of the prosencephalon and the diencephalon to prevent the appearance of

Read at a meeting of the Philadelphia Laryngological Society, March 7, 1939

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1 Spiegel, E. *Ztschr f Hals-, Nasen- u Ohrenh* **25** 200, 1929

2 Spiegel, E A, and Sommer, I. *Ophthalmo- und Oto-Neurologie*, Berlin, Julius Springer, 1931. Here also further references may be found

nystagmus on labyrinthine stimulation (Bauer and Leidler³ and Magnus and de Kleijn⁴)

The proprioceptor theory is refuted by the production of nystagmus when the proprioceptors have been paralyzed by the injection of procaine hydrochloride into the ocular muscles (de Kleijn⁵)

The ocular muscle nuclei theory is refuted by the failure, when only one oculomotor nucleus remains connected with the vestibular nuclei, of the internal rectus muscle innervated by the opposite third nucleus to contract rhythmically on labyrinthine stimulation (Spiegel¹) This shows that the mutual connections of the two oculomotor nuclei are unable to produce the rhythm

The labyrinthine theory is refuted by the failure of elimination of both labyrinths to prevent nystagmus of central origin⁶ (Bechterew's compensatory nystagmus or nystagmus following punctures of the vestibular nuclei [Spiegel and Sato⁷])

Thus the problem is restricted to the alternative between the vestibular nuclei theory (II₄) and the reticulate substance theory (II₅) A participation of the reticulate substance in the conduction of the labyrinthine impulses to the nuclei of the ocular muscles is indicated by the experience that severance of the posterior longitudinal fasciculus does not prevent nystagmus when the labyrinth is stimulated (Lorente de No⁸ and Spiegel¹) Yet, after he had produced large lesions of the reticulate substance⁹ by puncturing the brain stem from the ventral aspect, thus avoiding lesions of the vestibular fibers entering the posterior longitudinal fasciculus, Spiegel¹ still observed nystagmus with both components on rotation He therefore inclined toward the vestibular

3 Bauer, J, and Leidler, R Arb a d neurol Inst a d Wien Univ **19** 155, 1912

4 Magnus, R, and de Kleijn, A, in Alexander, G, and Marburg, O Handbuch der Neurologie des Ohres, Berlin, Urban & Schwarzenberg, 1923, vol 1, p 465

5 de Kleijn, A Arch f Ophth **107** 480, 1922

6 In these cases both phases of the nystagmus are of course of central origin, as Dusser de Barenne (Handbook of General Experimental Psychology, edited by C Murchison, Worcester, Mass, Clark University Press, 1934, p 210) pointed out This does not, however, invalidate the conclusion that the labyrinths are not a necessary part of the mechanism producing the rhythm

7 Spiegel, E, and Sato, G Arch f d ges Physiol **215** 106, 1926

8 Lorente de No, R Die Labyrinthreflexe auf die Augenmuskeln, Berlin, Urban & Schwarzenberg, 1928

9 In some experiments (Spiegel,¹ fig 3) the lesion (hemorrhage and surrounding edema and necrosis) reached close to the posterior longitudinal fasciculus The objection that the lesion was not sufficient is therefore hardly justified

lar nuclei theory, while Lorente de No,¹⁰ observing disturbances in the ocular reactions to labyrinthine stimulation and also loss of the quick component (tonic deviation only) after puncturing the reticulate substance from the dorsal aspect, stated that these experiments indicate that cell groups outside the vestibular nuclei, in particular parts of the reticulate substance, are responsible for the production of the rhythm. In view of the importance of Lorente de No's observations for our problem, it seemed desirable to continue experiments in this direction, particularly not to limit the observations, as Lorente de No did, to the acute stage following operation but to observe the further course of the changes in the ocular reaction following labyrinthine stimulation.

METHOD

The operation on the floor of the fourth ventricle was performed on cats under anesthesia induced by pentobarbital sodium. A catheter was introduced into the trachea during operation, so that artificial respiration could be quickly performed if necessary after the medulla was punctured. The floor of the fourth ventricle was exposed in the usual way. The posterior atlanto-occipital membrane and the adjacent parts of the occipital bone were removed, and the cerebellum was gradually elevated. The incision was made in or close to the midline of the fossa rhomboidalis with a thin, double-edged knife. This operation did not interrupt spontaneous respiration in some of the experiments, but in others artificial respiration was necessary from one-half to one hour.

The labyrinth was stimulated by rotation, by galvanic stimulation (one electrode in each external meatus) and by caloric stimulation. For the latter purpose cold water was conducted through a U-shaped metal cannula that was introduced into the external meatus.

RESULTS AND COMMENT

Two types of lesion may be distinguished.

1 Paramedian punctures affecting not only the reticulate substance but also fibers from the ipsilateral vestibular nuclei into the posterior longitudinal bundle or lesions through this bundle, which sometimes involved also the nucleus or roots of the sixth nerve.

2 Median (middle line) incisions, leaving the posterior longitudinal fasciculus intact and severing only the fibers crossing in the raphe.

The following experiments may illustrate the first type (paramedian lesions).

CAT 1—On Feb. 15, 1938, an incision was made into the floor of the fourth ventricle with the animal under anesthesia induced by pentobarbital sodium. Spontaneous respiration continued after operation.

On February 16 the animal lay on the left side and was able partly to raise the head. The head showed a tremor, and the cat could sit up partly and move

¹⁰ Lorente de No, R. Vestibulo-Ocular Reflex Arc, *Arch. Neurol. & Psychiat.* 30:245 (Aug.) 1933.

it to either side. There was slight deviation of the eyeballs to the left but no spontaneous nystagmus. The longitudinal diameter of the right pupil was rotated 5 degrees outward and that of the left pupil 17 degrees inward.

The results of rotation were as follows:

10 rotations to right	No nystagmus
10 rotations to left	Increased deviation of right eye to left (inward), eye remains for $\frac{1}{2}$ minute in this position
10 rotations to right	Distinctly decreased deviation to left of right eye, followed by 7 to 8 horizontal undulations without a discernible fast or slow component
10 rotations to left	Tonic deviation to left and nystagmus with small amplitude to right, particularly distinct in right eye

Galvanic stimulation with electrodes in both external auditory meatuses produced the following reactions:

Cathode in left meatus (5 ma)	Distinct coarse nystagmus to left
Cathode in right meatus (5 ma) (8 ma)	Only deviation of eyes to left, no nystagmus Deviation to left and few jerks of small amplitude to right

On February 18 spontaneous vertical nystagmus was present (20 jerks per minute). Repeated rotation with the head in the normal position produced the following results:

10 rotations to right	22 jerks to left in 12 to 13 seconds
10 rotations to the left	27 to 33 jerks to right in 14 to 17 seconds

With the head fixed in a side position (right ear up), the eyes were spontaneously deviated downward (to the lower lid), vertical nystagmus to the upper lid was diminished to 2 jerks of small amplitude per minute, and rotation produced the following results:

10 rotations to left	29 jerks downward in 17 seconds
10 rotations to right	5 weak jerks upward in 14 seconds

With the head fixed in a side position (left ear up), spontaneous nystagmus occurred in groups of jerks, partly beating toward the lower lid (16 jerks per minute) and partly beating toward the left canthus (10 jerks per minute), and rotation produced the following results:

10 rotations to right	46 coarse jerks downward in 23 seconds
10 rotations to left	8 jerks upward and somewhat to the left in 14 seconds

Summary—One day after the operation, rotation elicited only tonic deviation, later, rotation to the right produced undulation without a discernible fast or slow component, and rotation to the left produced nystagmus to the right with a

small amplitude By galvanic stimulation (5 milliamperes) nystagmus to the left, and with somewhat stronger current (8 milliamperes) also to the right, could be elicited Three days after the operation distinct horizontal nystagmus to the left, as well as vertical nystagmus (up and down), could be elicited by rotation

Histologic Examination—The incision started on the floor of the fourth ventricle between the right posterior (medial) longitudinal fasciculus and the right knee of the facial nerve It took its course inward from and parallel to the roots of the right sixth nerve, more cranially it transversed the corpus trapezoideum, and on sections through the anterior part of the pons it reached the ventral surface after passing through the pyramidal tract

CAT 2—On March 1, 1938, an incision was made into the floor of the fourth ventricle with the animal under anesthesia induced by pentobarbital sodium

On March 2 the cat could sit up but had ataxic movements of the head Spontaneous nystagmus was present (occasional vertical jerks, sometimes upward and sometimes downward)

Repeated rotation with the head in the normal position produced the following results

10 rotations to right	23 to 24 distinct jerks to left in 16 to 20 seconds
10 rotations to left	In some experiments, only fine tremor of the eyeballs, in some, jerks to right and upward with small amplitude (16 jerks in 15 seconds)

With the head fixed in a side position (right ear down) distinct spontaneous nystagmus toward the lower lid was present

With the head fixed in a side position (left ear down), occasional spontaneous vertical nystagmus toward the upper lid occurred, and rotation produced the following results

10 rotations to right	10 jerks to upper lid in 8 seconds
10 rotations to left	19 jerks to lower lid in 15 seconds

On March 3 the cat could sit and stand, the head was slightly turned to the right, and a slight tendency to fall to the right was present

With the head in the normal position, no spontaneous nystagmus occurred, and rotation produced the following results

10 rotations to right	26 jerks to left and downward in 18 seconds
10 rotations to left	In 1 experiment, no definite nystagmus, in another, 5 horizontal undulations with small amplitude, in further tests, 18 to 22 jerks downward in 17 to 22 seconds

With the head fixed in a side position (left ear down) spontaneous nystagmus to the lower lid was present (60 jerks in 30 seconds)

With the head fixed in a side position (right ear down), spontaneous nystagmus to the lower lid was present (57 jerks in 30 seconds), and rotation produced the following results

10 rotations to right	Frequency of spontaneous nystagmus increased
10 rotations to left	Inhibition of spontaneous nystagmus for 15 seconds, 1 to 2 jerks to upper lid, followed by reappearance of spontaneous nystagmus

Galvanic stimulation with electrodes in both external auditory meatuses produced the following reactions

Cathode in right meatus (8 ma)	9 jerks of small amplitude to right in 30 seconds
Cathode in left meatus (5 ma)	36 to 58 distinct jerks to left in 30 seconds (fig 1)
Cathode in right meatus (9 ma)	11 jerks downward and slightly to right in 30 seconds

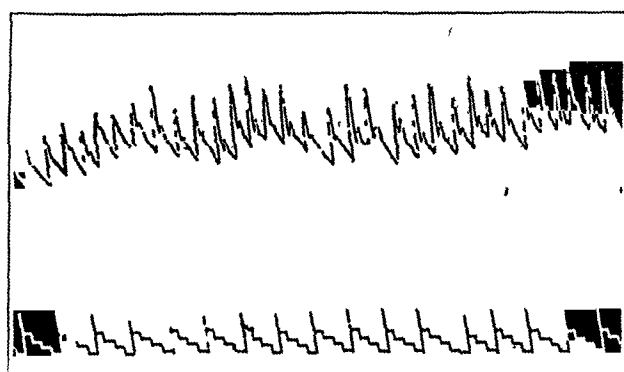


Fig 1 (cat 2) —Galvanic nystagmus (anode in the right and cathode in the left external auditory canal) Upward lines in the graph represent ocular movements to the left The lower lines indicate time in seconds

With the head in the normal position, spontaneous vertical nystagmus upward was present (5 to 10 jerks in 30 seconds), and rotation produced the following results

10 rotations to right	Horizontal undulations (15 jerks in 19 seconds)
10 rotations to left	Eyes deviated somewhat downward, nystagmus upward and rotary to right (5 jerks)
10 rotations to left	4 to 5 rotary jerks to right in 17 seconds

Caloric stimulation produced the following reactions

Cold water irrigation (left ear)	Vertical nystagmus upward (16 jerks in 1 minute)
Hot water irrigation (left ear)	Vertical nystagmus upward (22 jerks in 1 minute)
Spontaneous nystagmus	6 to 15 jerks in 1 minute (upward)
Cold water irrigation (right ear)	Nystagmus to left (36 jerks in 30 seconds, some of jerks upward)

Hot water irrigation (right ear)	Deviation downward and somewhat to left, 5 upward jerks of large amplitude per minute
Spontaneous nystagmus	4 upward jerks of small amplitude per minute

On March 8, with the head in the normal position, spontaneous slow upward and downward movements of the eyeballs occurred, and rotation produced the following results

10 rotations to right	Nystagmus to left (12 to 15 jerks in 7 to 15 seconds)
10 rotations to left	11 jerks rotary to right
10 rotations to left	12 jerks down and rotary to left
10 rotations to left	Tonic deviation downward and single jerk to right, sometimes only downward deviation

With the head fixed in a side position (left ear down) rotation produced the following results

10 rotations to right	7 jerks to upper lid in 10 seconds
10 rotations to left	6 jerks to lower lid in 8 seconds

The cat died during the night of March 8 to March 9

Summary—The lesion produced spontaneous vertical nystagmus (mostly upward but sometimes downward)

Rotation Nystagmus to the left could be elicited as early as one day after the operation. Nystagmus to the right could be produced rather rarely, on the first day after operation it had a small amplitude, but also in the following days it was impaired, easily exhausted and replaced by vertical nystagmus. Vertical nystagmus in either direction could well be produced.

Galvanic Stimulation Distinct nystagmus to the left could be produced. Nystagmus to the right appeared on application of strong currents (8 to 9 ma) only, it had a smaller amplitude and a lower frequency and was easily exhausted, after which downward nystagmus became manifest.

Caloric Stimulation Irrigation of the left ear with cold as well as with hot water produced only an increase of the spontaneous upward nystagmus. Irrigation of the right ear with cold water elicited distinct nystagmus to the left, on irrigation of this ear with hot water deviation downward and to the left appeared. Nystagmus to the right could not be elicited. Thus the impairment of the nystagmus to the right was most marked on caloric stimulation.

Histologic Examination—A paramedian incision on the right side entered the floor of the fourth ventricle through and immediately in front of the right sixth nucleus. The right posterior (medial) longitudinal fasciculus was destroyed by the lesion except for its most medial fibers (fig 2A). Also the systems ventrally adjacent to the posterior longitudinal fasciculus were destroyed. The puncture coursed through the reticulate substance in a ventrocranial direction, remaining in a paramedian position and parallel to the raphe and dividing into two punctures above the pyramidal tracts, at the level of the decussation of the trochlear nerve. The lesions lay on the medial border of the pyramidal tract in the level of the posterior quadrigeminal bodies (fig 2B). On the left side a small hemorrhage was noted between the knee of the roots of the facial nerve and the substantia gelatinosa of the fifth nerve.

It is conceivable that the lesion in cat 2, affecting the right sixth nucleus and also the ipsilateral posterior longitudinal fasciculus and the ventrally adjacent vestibulomesencephalic tracts, impaired the nystagmus to the right side, which was easily exhausted yet not completely lost, for by rotation and galvanic stimulation it could still be elicited with small amplitude, while caloric stimulation failed to produce it, producing instead reactions in a vertical direction (increase of a spontaneous upward nystagmus or deviation to the left and downward). It is of interest to compare the reactions of this animal with those of cat 1, in which the lesion was located between the right posterior longitudinal fasciculus and the knee of the roots of the facial nerve, then causing

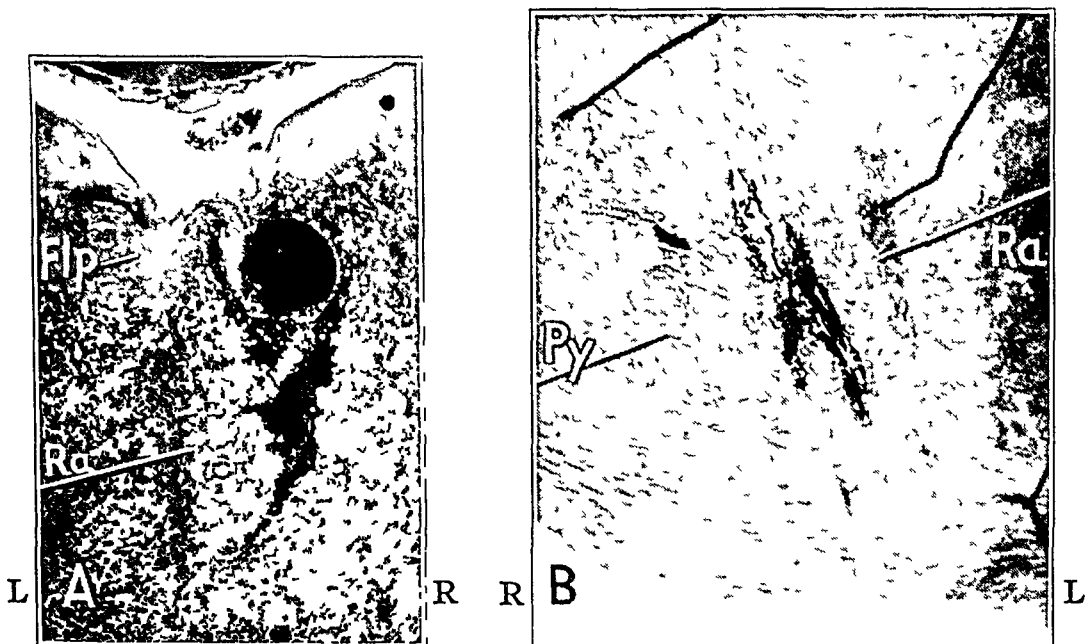


Fig 2 (cat 2) —*A*, section through the pons in front of the sixth nucleus *B*, section through the posterior corpora quadrigemina *Flp* indicates the fasciculus longitudinalis posterior, *Py*, the pyramidal tract, *Ra* the raphe, *R*, right, and *L* left

medially to the roots of the sixth nerve, here only in the first days after operation were difficulties in the production of nystagmus encountered, and as early as three days after operation rotation produced horizontal as well as vertical nystagmus in either direction

Still more important for our problem is the second type of lesion the exactly median incision, illustrated in the following experiment

CAT 3—On March 15, 1938, incision was made in the median sulcus of the rhomboid fossa, with the animal under anesthesia induced by pentobarbital sodium, no disturbance of respiration occurred

On March 16, with the head in the normal position, the animal showed no spontaneous nystagmus, and rotation produced the following results

10 rotations to right	Slight deviation of eyeballs to right, no nystagmus
10 rotations to left	Distinct deviation of eyeballs to left, no nystagmus

With the head fixed in a side position (left ear down), no definite spontaneous nystagmus but a fine tremor of the eyeballs was present, and rotation produced the following results

10 rotations to right	1 jerk to upper lid, followed by 10 jerks of small amplitude toward right canthus, with slight component upward
10 rotations to left	5 jerks of small amplitude toward lower lid
10 rotations to right	15 jerks upward (first two of large amplitude, subsequent ones of small amplitude)

With the head fixed in a side position (right ear down), spontaneous nystagmus toward the lower lid was present (20 jerks of small amplitude per minute), and rotation produced the following results

10 rotations to right	Amplitude of spontaneous nystagmus somewhat increased, frequency, 12 jerks in 20 seconds
10 rotations to left	5 jerks toward upper lid, followed by reappearance of spontaneous nystagmus

Galvanic stimulation with electrodes in both external auditory meatuses produced the following reactions

Cathode in left meatus (8 ma)	Deviation of eyeballs to right, minimal nystagmus (small amplitude) to left
Cathode in right meatus (8 ma)	Deviation of eyeballs to left, somewhat more distinct nystagmus to right and slightly upward

On March 17, with the head in the normal position, no spontaneous nystagmus was present, and rotation produced the following results

10 rotations to right	3 distinct jerks to left, tonic deviation to right outlasting these jerks, duration of whole reaction, 23 seconds
10 rotations to left	10 jerks to right in 16 seconds
10 rotations to right	6 jerks to left in 19 seconds

With the head fixed in side position (right ear down), spontaneous nystagmus to the left canthus was present (22 jerks in 30 seconds), and rotation produced the following results

10 rotations to right	12 jerks toward lower lid in 14 seconds
10 rotations to left	12 vertical jerks in 24 seconds, first toward upper, then toward lower, lid

10 rotations to left

17 vertical jerks in 20 seconds (first 3 toward upper, then 4 toward lower, then again toward upper, lid)

Galvanic stimulation with the electrodes in both external auditory meatuses produced the following reactions

Cathode in right meatus

Distinct nystagmus to right (18 jerks per minute)

Cathode in left meatus

Nystagmus to left with component upward (30 jerks per minute)

The nystagmus was much more distinct (larger amplitude) than on the previous day

Summary—One day after the lesion, rotation produced only horizontal deviation of the eyeballs but failed to produce horizontal nystagmus in either direction. Vertical nystagmus, upward as well as downward, could be elicited. Galvanic stimulation was able to produce nystagmus with small amplitude to the left and more distinct nystagmus to the right.

Two days after operation, rotation produced horizontal as well as vertical nystagmus, and the horizontal nystagmus on galvanic stimulation had a larger amplitude than on the previous day.

Histologic Examination—The incision started behind the sixth nucleus, at the level of the triangular nuclei and the cochlear ganglions (fig 3A), it lay exactly in the median line separating the posterior longitudinal fasciculi of either side. A section through the sixth nucleus and the knee of the roots of the facial nerve showed the puncture exactly in the raphe (fig 3B), reaching close to the corpus trapezoidum and separating the right and the left reticulate substance from each other. In the most cranial part of the pons, the lesion, which still extended dorsally to the corpus trapezoidum, deviated slightly from the median line. At the level of the decussation of the roots of the fourth nerve it lay between the medial lemnisci and the pyramidal tracts of either side. Its ventral end lay between the pyramidal tracts at the level of the inferior colliculi (fig 3C).

There were hemorrhages and necrosis in the ventrocaudal part of the vermis cerebelli.

In this case the puncture severed just those fibers which are according to Lorente de Nó¹⁰ of importance for the production of the quick component (of the rhythm) of nystagmus¹¹. He wrote

a longitudinal lesion cutting the pathways which cross the middle line between the level of the oral end of the motor nucleus of the trigeminus and the level of the caudal end of the tuberculum acusticum is enough to change the rhythmic nystagmus into a pseudopostural reflex.

He stated that particularly the pathways crossing the middle line at the level of the anterior third of the sixth nucleus are of great importance.

¹¹ Lorente de Nó's experiments were performed on rabbits, but the conclusions drawn from these experiments should, of course, be applicable to other mammals too.

Yet despite the cutting of these fibers we found that only on the first day after operation did rotation fail to elicit the rhythmic reaction producing instead tonic deviation of the eyeballs. As soon as two days after operation rotation produced not only vertical but also horizontal nystagmus in either direction. The galvanic nystagmus had a small

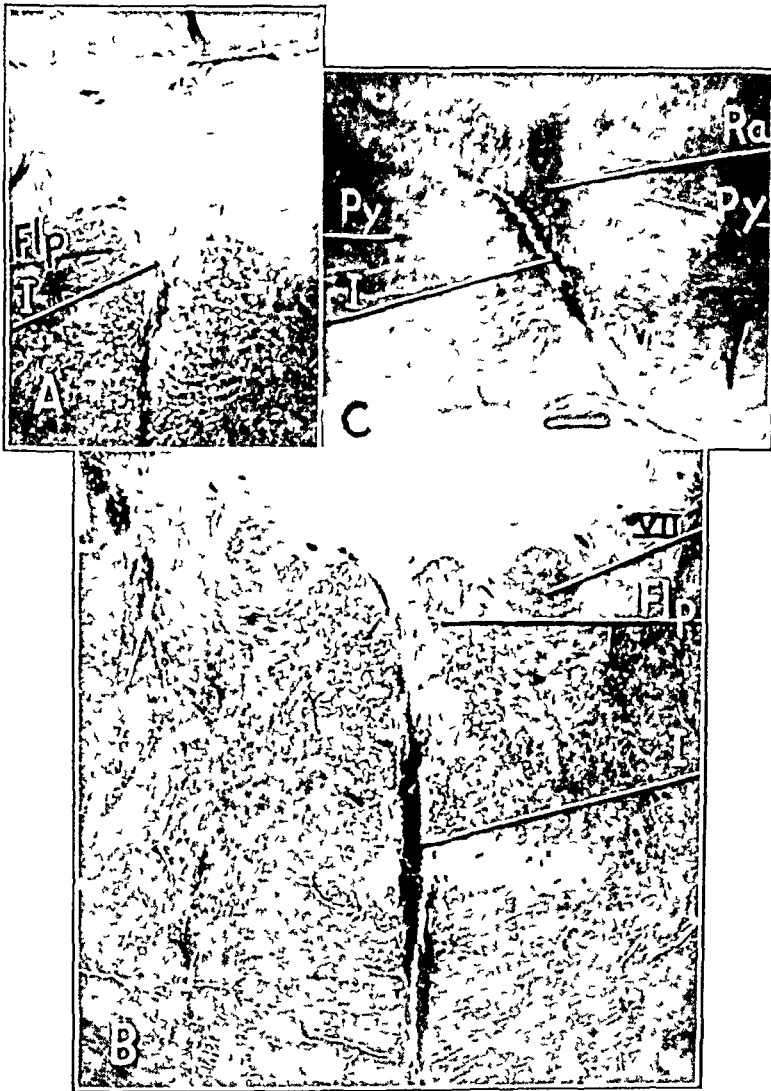


Fig 3 (cat 3) —*A*, section through the anterior end of the medulla oblongata behind the sixth nucleus. *B*, section through the pons at the level of the sixth nucleus and the knee of the root of the seventh nerve. *C*, section through the posterior corpora quadrigemina. *Flp* indicates the fasciculus longitudinalis posterior, *I*, the incision, *Py*, the pyramidal tract, *Ra*, the raphe, and *VII*, the knee of the root of the facial nerve.

amplitude on the first day after operation, but was much more distinct (larger amplitude) on the second day.

CONCLUDING OBSERVATIONS

Reviewing these experiments, we may first confirm the observation of Lorente de Nó that punctures into the reticulate substance and the raphe of the rhombencephalon, respectively, from the floor of the fourth ventricle may induce disturbances in the ocular reactions on labyrinthine stimulation, so that in an initial postoperative stage tonic deviation of the eyeballs is elicited instead of the rhythmic reaction. Reactions in a false direction also may be observed. The difficulty in producing the rhythmic reaction is particularly pronounced on caloric stimulation, probably because it is rather weak.

However, if the animals are examined beyond the acute stage, one finds, especially if concomitant lesions of the posterior longitudinal fasciculus system and of the nucleus and roots of the sixth nerve are avoided, that these disturbances are reversible to a great extent and that rhythmic ocular reactions may reappear.

Particularly on stimulation by rotation and by galvanic current, as early as a few days after operation horizontal nystagmus (to the left as well as to the right) and vertical nystagmus (up as well as down) can be produced, beating in the proper direction according to the stimulus applied. In seeking the origin of the rhythm one has, therefore, to bear in mind that the suppression of the rhythm observed after puncture of the reticulate substance and of the raphe, respectively, is only short-lived. The finding that lesions outside the vestibular nuclei affecting the reticulate substance may prevent the formation of the rhythmic response on labyrinth stimulation can hardly be used as an argument against the vestibular nuclei theory and in favor of the reticulate substance theory, in view of the transitory nature of the disturbance. It should also be pointed out that disturbance of the equilibrium between the centers of the left and the right side produced by punctures of the reticulate substance without lesion of the fibers from the vestibular nuclei to the fasciculus longitudinalis posterior does not result in such symptoms of spontaneous nystagmus as are observed after puncture of the vestibular nuclei, such spontaneous nystagmus should be expected if the rhythm originated in the reticulate substance. Thus, there seems to exist no proof that the rhythm of nystagmus originates in the reticulate substance, lesions of this region either not destroying the rhythm at all (former experiments of Spiegel¹) in which the brain stem was punctured from the ventral aspect or disturbing it only transitorily (present series of experiments). Since all other possibilities also were excluded, as pointed out in the introductory survey, there remains only the possibility that the rhythm takes its origin in the vestibular nuclei. It should be emphasized that the experiments reported in this paper and the conclusions based on these experiments do not invalidate the view

that an important bypath for the conduction of labyrinthine impulses to the ocular muscles takes its way through the reticulate substance Lorente de Nó is to be credited with having first demonstrated the existence of this bypath

SUMMARY

The effect of punctures of the reticulate substance and also punctures in the raphe of the rhombencephalon on ocular reactions following stimulation of the labyrinth was studied by experiments on cats, with special reference to the restitution of function

The suppression of the rhythmic reaction (substitution of tonic deviation) found in the acute experimental stage subsides in the first few days after operation, so that again rhythmic ocular reactions with a slow and a quick component are obtained on labyrinthine stimulation (particularly rotation and galvanic stimulation) These observations seem to support the view that the reticulate substance is not indispensable in the mechanism of nystagmus and that the origin of the rhythm must be in the vestibular nuclei

HEADACHE FROM PATHOLOGIC CHANGES IN THE NOSE OR OTHER CAUSES

DIFFERENTIAL DIAGNOSIS

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Headaches or neuralgias which are really secondary to or dependent on pathologic changes in the nose and sinuses should not offer great difficulties in differential diagnosis, certainly not in the practice of the members of the American Laryngological Association

Headaches or neuralgias from other causes may offer abundant difficulties in differential diagnosis to members of this special group or to other physicians, especially if a careful history, family and personal, is not given precedence over physical findings and roentgen evidence

To limit the field of discussion, I choose to consider under "other causes" only those headaches or neuralgias, with associated symptoms, which appear periodically for months or years or most of a lifetime in the ambulatory or ordinary office patient. Such patients usually carry on most of their regular duties and enjoy good health except for short periods of marked discomfort. Real pathologic changes in the face or head, or elsewhere in the body, for that matter, are usually not the main consideration. In most instances only subjective symptoms are present, with no objective evidence to further a diagnosis. Transient disturbances of vasomotor origin in the brain, meninges, ganglions or nerve sheaths, whether spoken of as migrainous, allergic or functional upsets, are responsible for the symptom complex in most instances.

If otolaryngologists practice their specialty first as physicians, they will be truly interested in the symptoms brought forth by a careful history, if, however, they practice purely as specialists in the field of otolaryngology, they may be blinded by physical signs and roentgen evidence, which can, and often do, confuse rather than clarify differential diagnosis. Most of the periodic headaches, especially those with associated general symptoms, mild or severe, which are encountered in everyday office practice are not due to local irritation of the nerve ends in the nose, sinuses, teeth or eyes. They are more likely to be due to circulatory changes of some type in the brain, meninges, ganglions or

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nerve sheaths. These circulatory changes are as general in nature as are those in arteriosclerosis, asthma and many conditions involving the skin or the gastrointestinal tract. The fact that the symptoms, headache and neuralgia, though subjective, are closely associated anatomically with objective evidence of pathologic changes in the nose or of sinus disease leads to many errors in diagnosis.

There is a function for small specialized groups in the study of special problems in the diagnosis of the various ills which beset the human race, but there is, in my opinion, an equally good and more sufficient reason why such specialists should rule out first the general problems which are constantly complicating the specialized fields of practice. It seems reasonable to express the opinion that in many of the meetings of otolaryngologists and in much of their literature too much stress is placed on rare conditions and cases in which difficulties occur and too little is said of what is done about everyday problems in everyday practice. Most of the otolaryngologist's patients come to him because he is a Doctor of Medicine, they naturally assume that his horizon is not limited by any artificial divisions of their bodies or of his medical thinking.

In many instances the diagnosis of the probable cause of periodic headache or neuralgia and associated symptoms depends to a great extent on the specialty of the physician who examines the patient. Migraine as a dramatic syndrome of vasomotor, allergic or functional origin is protean in type. The visual symptoms, such as scintillating scotomas or hemianopia, usually take the patient to the ophthalmologist, the frontal headache, bone tenderness and nasal symptoms suggest the otolaryngologist, nausea and vomiting call for a surgeon to consider the appendix or gallbladder, paresthesia, transient aphasia or amnesia interest the neurologist, the high incidence of the syndrome in women and the common relation of the attacks to the menstrual period and the menopause allow the gynecologist to consider the possibility of endocrine treatment or pelvic operation to relieve possible reflex irritation. Physicians who have never been subject to headache rarely take any particular interest in the associated symptoms, so indicative of involvement of the cortex of the brain. To them such complaints are simply evidence of "nervousness" and are rarely given careful consideration.

Given a symptom complex with such unlimited possibilities for surgical or other treatment in any of the special fields of the practice of medicine and given the type of patient who has usually a long span of life with good health between the attacks of the disease and the attacks of those who would relieve it, I am reminded of the statement so seriously made to me by my mother in my youth: "Remember, son, your body is fearfully and wonderfully made."

I wish to make clear that the statements made in this paper are based mainly on personal observations during the past seventeen years and that many of these statements disagree essentially with those made by some writers who class as authorities. Though I may disagree, I intend never to belittle the beliefs or ideas of other physicians. Progress in any field of scientific endeavor must be made by stumbling ahead over some fallen bricks originally placed by older and equally conscientious workers. My particular interest in the differential diagnosis of the principal causes of periodic headache and associated symptoms dates to my personal experience as a victim of migraine and not to the completion of academic work in medical school or of postgraduate studies in otolaryngology. During the years in which I have been particularly interested in the problems of periodic familial headache, I have marveled at the little stress placed on the prevalence and the symptoms of this condition in medical schools and postgraduate courses. Students, interns and practitioners in conversations in the hotel room or lobby often give the impression that I have discovered a new and rare condition. Actually it is estimated by authorities that from 5,000,000 to 9,000,000 victims of migraine are now living in the United States.

Careful study of the voluminous writings concerning these vasomotor outbursts, I am loath to say, but must say to be true to my subject and myself, has caused much disappointment and discouragement as to the value of quantities of the recorded literature. The records have been for hundreds of years and are now replete with glowing descriptions of methods which have relieved periodic attacks of headache or neuralgia of probable vasomotor origin, with associated symptoms, but little has been said as to whether the treatments given or operations done have prevented the recurrence of similar attacks. Listing from the literature the many causes of periodic vasomotor headache and the treatments advised makes one realize that this is a condition closely related to hay fever and asthma in more ways than one. Every one knows that throughout the years many enthusiastic reports of procedures advocated to relieve or cure various allergic conditions have had to be discarded after sufficient time has elapsed to allow for the recurrence of the symptoms.

It has been my experience, and I am sure it will be that of the reader, if he carefully follows for long periods patients who give symptoms of migraine or some type of vasomotor headache or neuralgia, that more of them lose their symptoms *spontaneously* than after all treatments and operations combined. There is no doubt that many of these spontaneous or natural cures are credited to some treatment or operation which they follow because of coincidence. Just getting older accounts for more cures than all treatments and operations. Rarely does a patient over

60 go to a physician with the complaint of headache. Headache and neuralgia, of course, are purely subjective symptoms, and knowledge of their probable type and possible severity must depend to a great extent on the individual patient's intelligence or ability to express himself. The term "headache," as the patient uses it, may describe a real pain, a peculiar sensation, a feeling of pressure or a purely psychic disturbance. It may at times express purely a defense reaction or be used as a basis for a claim in litigation.

MECHANICS OF HEADACHE

Much has been written but little is actually known concerning the actual mechanics or pathologic process of the production of headache or neuralgia. It is known that there are nerves of sensation in the dura, but there are supposed to be none in the pia or the arachnoid. Stretching of the dura gives pain, as can easily be demonstrated at operation. Some experimental work has demonstrated that nerves of sensation are found only around the blood vessels. The mechanism of the production of the pain and associated symptoms in migraine is supposed by some to be explained by alterations in the pressure of cerebrospinal fluid in the basal cisterna. Practically, for the purpose of this paper, it seems reasonable to assume that local tissue reactions in the brain substance, meninges, ganglions or nerve sheaths, similar to the local tissue reactions of urticaria or angioneurotic edema, may explain the regular progression of the pain and associated cortical symptoms in migraine or other types of vasomotor headache. This statement contains nothing new or original, but I feel sure from my contacts with physicians and from my studies of the literature that this theory is not given the importance it deserves. No theory of venous stasis or temporary pressure from misplaced spinal fluids could possibly explain the regular progression of cortical symptoms from the occipital visual area to the sensory area, and possibly then often to the speech center with no involvement of the motor area. Never in my experience has the motor area of the brain been involved in any vasomotor outburst, whether spoken of as migraine or as allergic or functional headache. In urticaria, certain areas of the skin are affected, with intervening areas of normal tissue, so it does seem reasonable to think of, though one cannot see, certain similar areas of local tissue reaction in the brain, meninges, ganglions or nerve sheaths during a vasomotor disturbance in these tissues.

IMPORTANCE OF ASSOCIATED CORTICAL SYMPTOMS IN DIFFERENTIAL DIAGNOSIS

Scintillating scotomas (dancing, zigzag lines or spots before the eyes), hemianopia (loss of vision in one field) and blurring of the entire visual field are typical prodromal symptoms in many patients with

migraine, and certainly repetition periodically of such symptoms with periods of normal visual function must suggest that the pain in the head and other associated symptoms which follow have a vasomotor basis. Some patients, as they grow older, may experience only the visual phenomena, without any headache or other associated symptoms.

Paresthesia (numbness in hand, arm, lips or tongue) commonly appears with the visual symptoms or soon after they have developed. If this numbness appears on the left side, the headache will often be present on the right side, which, of course, suggests the cortical involvement of the sensory area. Such symptoms are usually of short duration and are elicited only by a careful history.

Nausea and vomiting are commonly present and usually are most troublesome when the headache is most severe. These symptoms are much more common in the child and the young adult than in the older patient. In fact, it is almost axiomatic that their severity varies in inverse proportion to the age of the patient. Real gastric or intestinal conditions rarely cause headache of any severity, but many severe gastric and intestinal symptoms follow or are associated with headache of vasomotor origin.

Attacks of real rotation vertigo with pallor, perspiration, nausea and vomiting often appear as prodromal symptoms in an attack of migraine. What is of more importance, however, this symptom complex replaces the entire migraine syndrome in many patients for months or years. Such attacks are typical of Ménière's syndrome except that tinnitus and loss of hearing are not present. These attacks, because of their short duration and lack of after-effects, though they are common, are seldom diagnosed. Rarely does an otolaryngologist see such patients at the time of their attacks, and rarely does the general physician, who does see them, consider the real nature of the disturbance. The diagnosis is usually heart trouble or acute indigestion, because the gastrointestinal symptoms and the appearance of the patient are dramatic, and little may be said concerning the causative vertigo. As a rule the general physician does not need to give much thought to the actual nature of the disturbance or to call the otologist in consultation, because the attacks are of short duration and the patient is up and around as well as ever in a few minutes, an hour or a day. The patient recovers quickly regardless of, and usually in spite of, the treatment advised. It is extremely rare for the disability to last as long as twelve hours, and in many instances the effects may be gone within a few minutes or an hour. I have seen few of these attacks but have heard of a great many while taking histories in the office. In only 1 instance have I seen rotatory nystagmus, but in that case it was typical of irritative labyrinthitis during the few seconds it was observed. For over two years vertiginous attacks of short duration

replaced my own migraine syndrome, and I assure the reader that the patient suffering with this condition has reason to be seriously disturbed and anxious to be assured that there is no real pathologic change in the brain or elsewhere. Little has been said in the literature concerning this type of Meniere's syndrome, but I feel sure after interviewing patients with vasomotor disorders for many years that it is more common than any other form of vestibular disturbance. Occasionally, of course, a patient may have chronic progressive deafness and tinnitus coincidentally with a tendency toward vasomotor derangement. In such instances differential diagnosis is a real problem.

Aphasia and amnesia of short duration are fairly common in typical cases of migraine. These symptoms, however, are rarely mentioned voluntarily by the patient because of the secret fear that they indicate a real mental disturbance. Many other patients will not mention these complications in the ordinary history because previously, when they did go over their problems with some physician, they were told almost flippantly that they were "just nervous." Fortunately these symptoms are transient and are present only when the headache or some other associated symptoms are demanding most of the attention.

Symptoms referable to the motor area are mentioned simply to emphasize that apparently they rarely, if ever, appear during attacks of vasomotor origin. I have yet to see a patient with epileptic seizures during or after a vasomotor outburst. Naturally it would be possible for epilepsy and migraine to appear in the same person as a coincidence, but in my experience this association has not occurred.

Ophthalmoplegic migraine has been mentioned in the literature for many, many years and has often been given an important place in the classification of the types of this disease. If this term is used to indicate real involvement of some of the motor nerves to the eye as a part of the symptom complex of migraine, I have yet to observe such a case. In my experience, patients with such muscular involvement have eventually disclosed evidence of real pathologic changes, usually a tumor of the brain. It is my opinion that the term ophthalmoplegic migraine is a misnomer and should be deleted from the literature, except as designating a possible rare anomaly that many have never encountered. Ophthalmic migraine also has been used for years as a term to describe a symptom complex. It probably is a proper term when used simply to designate the type of migrainous attack which has unilateral headache in the region of one eye as the prominent symptom. It might be logical to use this term when one is referring to an attack of migraine which begins routinely with scotomas or some other visual disturbance.

Comment—The associated symptoms mentioned may play a great part in the differential diagnosis of the probable cause of periodic head-

ache or neuralgia. All of these symptoms may appear in some patients, some of them in other patients and none in many. It is important to emphasize that probably no more than 25 per cent of patients suffering from periodic vasomotor headache have any of these associated symptoms. If, however, one or more of them appear in sequence during many periodic attacks of headache or neuralgia, with intervening periods of good health, the diagnosis is practically made, regardless of, and often in spite of, physical findings or other symptoms which have no bearing on the diagnosis. These physical findings, especially roentgen evidence, may easily confuse the issue because of their incidental presence in a region anatomically closely related to the location of the pain. And pain, we must always remember, is the main point of argument in any debate involving the patient, nature and the physician. No one of the individual symptoms is ever as typical as the periodicity of a certain number of them over long periods of time and the regularity of the progression of these symptoms in a patient whose personal and family history suggests possibilities of allergy or migraine. Certainly in many family histories, hay fever, asthma, urticaria and eczema may be interchangeable with migraine or some type of allergic or vasomotor headache.

Pain in the head, periodic and accompanied by such cortical symptoms as mentioned in various combinations can have no other basis than temporary tissue or fluid changes in the brain, meninges, ganglions or nerve sheaths. Real pathologic changes in the nose, sinuses, brain or other part of the head cannot be responsible for such systematic reproduction of similar explosive phenomena over long periods, with intervening periods of good health.

MIGRAINE IN CHILDREN

Migraine, or some type of vasomotor or allergic headache with associated symptoms, is much more common in children than is generally realized and deserves special mention in this paper. Little attention has been given to the subject in the textbooks on pediatrics or even in the current literature of this specialty.

At the age of 4 or 5, the headache itself is often a minor symptom of the periodic attacks, which are characterized by languor, loss of appetite, fever, abdominal discomfort and vomiting. Elevation of temperature, even to high levels, is common, and it may reach 105 or 106 F within a few hours after the beginning of the attack and then return to normal by the next day. The gastric disturbance in the young child is most marked, and nothing may be said either by the patient or by the parents concerning the headache in the earlier years. Many children have associated symptoms, such as scotomas, general blurred vision and paresthesia, at the beginning of the attacks, but the existence of such

prodromal symptoms may be elicited only by careful attention to the history. Abdominal distress and vomiting are dramatic and take the center of the stage. The association of these symptoms with fever naturally suggests an infective process to the parents and the general physician. During most of these periodic attacks either appendicitis or food poisoning are considered first as the probable diagnosis. Many children during the attacks also have symptoms referable to the nose and throat because of associated vasomotor rhinitis. Naturally the sinuses are often under suspicion, and in many instances the antrums have been explored and irrigated during each attack. Occasionally, an otolaryngologist is called in consultation by the general physician, partly because of the nasal symptoms but mainly because the high fever, normal leukocyte count and indefinite abdominal symptoms are difficult to classify, especially when identical attacks appear periodically. It is likely that in many instances so-called cyclic vomiting represents the early stages of what later becomes a typical migraine syndrome, with headache becoming a more prominent symptom as the child grows older. It is probable that many appendixes have been and are being removed in the hope of relieving these periodic gastrointestinal upsets in children.

One author has estimated that perhaps 1,000,000 children under 12 years of age in the United States are suffering from migraine. Another article in the literature states that approximately 7 per cent of the persons in this country have migraine some time in their lives and that about 30 per cent of all migraine sufferers manifest symptoms before they are 10 years of age. Another article estimates that 2 per cent of all children show some of the symptoms of the migraine syndrome during the first few years of life. A careful history, again, as mentioned before, is of much more importance than all possible physical findings. This case history will usually elicit evidence of hay fever, asthma, eczema or migraine or possibly all of the conditions in the family tree. Hereditary tendencies are of much more importance in arriving at a probable diagnosis of the cause of such periodic identical attacks than consideration of all the possibilities of acquired conditions.

SUMMARY

Headache, even when limited to the periodic type in the ambulatory or office patient, is an extensive subject, twenty minutes is a relatively short time in which to cover even the essential points in differential diagnosis. To conserve time and space, statements will now be made in outline form to cover much of the subject matter and act as a prolonged summary.

A history carefully elicited in relation to the patient and his ancestors is of more value in differential diagnosis of the probable cause of

periodic headache and associated symptoms than any and all types of physical examination

Headache due to acute nasal obstruction or sinusal disease should not and usually does not present any real problems in differential diagnosis. The pain in the head or face secondary to acute inflammation or infection of antriums or frontal or anterior ethmoid sinuses follows almost always in the wake of fairly typical symptoms of acute rhinitis of infectious origin. The pain or headache of acute involvement of the sphenoid sinus may cause confusion in differential diagnosis because of the possible lack of these premonitory nasal symptoms, but history, roentgen evidence and blood counts are fairly typical and dependable in this instance.

Headache secondary to chronic pathologic changes in the nose or sinuses rarely offers real diagnostic difficulties. Patients suffering with these chronic conditions do not commonly seek the advice of the otolaryngologist for relief of headache except during acute exacerbation of the nasal symptoms. They do, however, more commonly go to him for advice because of difficulty in nasal breathing, postnasal discharge, symptoms referable to the throat, chronic bronchitis or asthma.

Pathologic changes in the nose and sinuses are frequently found and easily visualized, especially in the roentgenograms. Vasomotor changes in the brain, meninges, ganglions and nerve sheaths are transient and are never seen. Therefore, it is only reasonable that what is most evident must in many cases seem most explainable. "Seeing is believing" is an old and worn platitude, but it often carries great weight, unfortunately, in the monotonous routine of daily office practice.

Classifications of headache and neuralgia as they appear in the literature are confusing and impractical for the practitioner who hopes to apply what he reads to what he does. Pain is a general symptom, anatomic distribution of nerve fibers and blood vessels can be demonstrated in the cadaver as a local fact, but the probable cause of the pain in any region may be as general in nature as the symptom itself.

In many instances, if the victims of chronic nasal obstruction or sinusal disease come for examination with a complaint of periodic headache or facial pain, it is naturally easy to associate these symptoms with physical and roentgen evidence of sinusal infection, when a careful history may clearly indicate that the pain is more likely to be of vasomotor origin. Such patients are commonly the victims of coincidence and often pay dearly for these accidental associations. The belief that they are victims of "sinus" (whatever that may be) has probably frequently been confirmed and strengthened over the years by innumerable treatments of, or operations on the nasal and sinusal structures. Reluctantly, I emphasize again what I have been saying for years, otolaryngologists

must rightfully assume much of the blame for the present complex regarding sinusal operations in the minds of the laity. Sufferers from migraine or allergy have been willing victims of all kinds of treatments and surgical procedures for years, mainly because they are usually intelligent people trying to rid themselves of a condition which causes marked disability periodically and interferes with their work and pleasure. They are willing and anxious to grasp any likely straw.

For many years, patients suffering from periodic headache and associated symptoms have had seriously impressed on them by the general practitioner, internist and surgeon, after many roentgen examinations and laboratory studies and often a short inquiry into the history, "Physically you are all right, your examination gives entirely negative results. As for your headache, it must be your eyes," or "it must be your sinuses." Actually, it might be more scientific, if not professional, for them to say to many of these patients, "It must be your ancestors."

Sphenopalatine and vidian neuralgia, probably secondary to involvement of the sphenoid sinus, may be clinical entities, but in my own limited experience in everyday office practice, they are almost mythical conditions, except as the syndromes commonly represent transient vasomotor upsets or are associated with a tender mandibular joint and poor dental occlusion. Many harmless sphenoid and posterior ethmoid sinuses have undoubtedly been mutilated because good anatomic work in the dissecting room has innocently led to poor clinical deductions.

Vacuum sinusitis, especially of the frontal sinuses, has been described frequently and has been given a prominent place in otolaryngologic literature by some good workers. According to the principles of physics and physiology, I am told on good authority, such a condition cannot be explained and probably does not exist. I have, however, encountered the symptom complex many, many times in patients whose personal or family history indicated without much doubt that the periodic pains had a vasomotor origin in the brain or meninges rather than in a vacuum in a sinus. Naturally removal of a septal obstruction or portion of a turbinate may give relief of pain for varying lengths of time, but probably it represents only one form of shock therapy in which operative insult to tissues is combined with psychic persuasion.

Pressure pain and headache supposedly due to deflected septums, enlarged turbinates or polyps also have been given a definite clinical place in the otolaryngologic field. Practically, in everyday experience, badly obstructed noses, with pressure from a deflected septum, a spur against the turbinates or large masses of polyps, are common, but often a history of pain or headache cannot be elicited.

Most of the patients who go through their daily business or social life complaining periodically of "sinus headache" are really suffering

from transient vasomotor disturbances within the brain substance or meninges instead of from pressure or infection within the sinuses. Treatment of the nasal membranes with astringents will give temporary relief to many patients with periodic headache as the main symptom, because the close anatomic vascular relation between the brain and the nasal structures allows vasomotor disturbances to be interchangeable. Most of the venous blood from the upper portion of the nose goes through the cribriform plate and then along the floor of the skull to the cavernous sinus. If such patients really had nasal infection, they could not recover periodically from every attack in a day or two through many years with no sequela or other evidence of infection.

Surgery of the nasal and nasal structures has improved rapidly and surely to a high position beside the surgery of the other specialties, but it must be admitted that it now stands much discredited in the minds of most patients and many general physicians. Differential diagnosis has been at fault and not the surgical procedures. Conservative treatment, so called, in the presence of real pathologic changes in the nose or sinuses is often more radical than proper surgical intervention. Most of the arguments against nasal and nasal operation have come, I think, because of the ill advised attempts to relieve or cure symptoms which the history clearly indicated were vasomotor or allergic in origin. All operations and many forms of treatment may act as "shock therapy" and give temporary relief from periodic attacks of any type of vasomotor disturbance, whether that disturbance is migraine, hay fever, or asthma or some other syndrome with a hereditary basis.

Spontaneous relief, temporary or permanent, of periodic headache or neuralgia with associated symptoms of vasomotor or allergic origin is more common than is similar relief from the combination of all treatments and operations in the otolaryngologic field and all other branches of medical practice. Inherited characteristics cannot be suddenly altered by measures which are successful in relieving acquired conditions. In the voluminous literature, medical writers have stressed the hopelessness of efforts to do anything for color blindness, hemophilia or congenital ocular diseases, but they have confidently and valiantly proposed or advised new treatments and operations to relieve or cure hereditary headache and its associated symptoms. Naturally, if one does not follow carefully a large number of patients for long periods of time, one may credit some treatment or operation with the relief that came as a spontaneous change. It is best to remember that patients with periodic pain in the head of the familial type usually have good health between attacks and usually live a full span of life. They then have ample time and opportunity to go from pillar to post, from physician to surgeon and from surgeon to quack.

Actually, those in the medical profession, regardless of the developments of various special fields of practice, have done little to relieve or cure patients with migraine or familial headaches. They have, however, in many instances done much to make them more uncomfortable. Many unfortunates lose their migraine spontaneously but retain distressing nasal symptoms the rest of their lives which are a direct result of ill advised operation on the septum, turbinates or sinuses. Lest otolaryngologists become too conscience stricken, it seems appropriate to mention that many appendixes, gallbladders and pelvic organs would still be functioning in their original surroundings but for other ill advised efforts to alter hereditary conditions by procedures which ordinarily give excellent results when used to remedy acquired difficulties.

All these years otolaryngologists, in their meetings and in the literature, have been told many things to do and how to do them, especially in relation to operation on the nose and sinuses. Much of this advice as to operation, even that given by some great authorities, would have been better left unsaid. In my humble opinion, it behooves more speakers and writers to stress now and then what often should not be done.

Patients suffering from migraine or some other form of hereditary vasomotor pain in the head and associated symptoms should often have nasal obstructions removed, sinuses drained, glasses prescribed, appendixes and gallbladders removed and various treatments given, but only when there are good and sufficient reasons for doing these things regardless of the vasomotor or allergic syndrome and not because of it.

CONCLUSION

Migraine and similar familial, allergic or vasomotor disturbances of the brain, meninges, ganglions, nerve sheaths and other bodily structures are common and probably will continue to be so as long as hereditary characteristics are perpetuated by intermarriage without thought to eugenic selection. Reduction in the numbers and severity of the symptoms and in the numbers of prospective victims is probably more a social than a medical problem. It is to be hoped that in the special field of allergy or of endocrinology or elsewhere consistent scientific effort will find methods to alleviate the symptoms more consistently over longer periods in a greater percentage of the patients who are predestined by heredity to suffer with these periodic upsets in a brain which is otherwise normal. In the meantime let otolaryngologists admit their limitations in the treatment of headache and neuralgia and reserve their scientific surgical procedures to cope with real pathologic conditions, which are and will always be present in the nose and sinuses.

IMPORTANCE OF VESTIBULAR FINDINGS FOLLOWING INJURY TO THE HEAD

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In 1928 I was privileged to present a paper before the Philadelphia Laryngological Society under the title "Interesting Cochlear and Vestibular Findings Following Accident"¹ It concerned itself in detail with findings and observations in a single case, and the conclusions drawn were therefore limited The present paper, dealing with a large and varied series of cases of the same sort, broadens understanding and emphasizes the importance of findings descriptive of a clinical entity more or less generally denied or ignored

In recent years there has arisen an increasing demand for better and clearer understanding and coordination of symptoms and objective findings in conditions resulting from injury to the head As man penetrates deeper into the mechanical age, demanding shorter and quicker productive means, tempo quickens, and human physical hazards unquestionably multiply Injuries of the head become proportionately common A review of the statistical increase in accidents to the head during the development of the machine age in general and the automobile age in particular is convincing Injuries of the head vary widely in character, severity and sequelae and become the concern of all physicians, particularly the industrial surgeon and the general practitioner, who make the earlier examinations Subsequent responsibility rests with the neurologist and neuro-otologist

From a medicolegal aspect, particularly where workmen's compensation laws apply, accurate consideration of the injured is of vital importance Not only must proof of disability be established, but its character, extent and ultimate outlook must be evaluated It is essential and timely, therefore, to add, if possible, further means of excluding unjust claims and awards and, at the same time, protecting claims that are genuine and worthy

When demonstrable fracture of the skull occurs, the problem of explaining and defining resulting pathologic changes and symptoms is usually simplified, but when the calvarium is injured and no demon-

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¹ Zacks, M A Interesting Cochlear and Vestibular Findings Following Accident, *Laryngoscope* 38 288, 1928

strable break in its bony continuity exists, the examining physician is frequently confronted with an admittedly perplexing problem. In the vast majority of cases of the latter type, subjective complaints far outweigh objective neurologic disclosures.

Many persons with a history of injury to the head, recent or of long standing, still receive routine examination, and the condition is diagnosed and disposed of as belonging to the post-traumatic group (for instance, neurasthenia, traumatic neurosis, psychoneurosis, hysteria and malingering). Definite organic cause is admitted when findings are fairly clear or self evident, but when neurologic findings are negative or questionable because the pathologic disturbance is obscure or varied in location, many conditions are misjudged as functional. Such diagnoses, though becoming less common, still too frequently appear on completed hospital records as the undisputed final opinion.

In such cases vestibular tests are of great value and, if performed precisely and systematically and properly interpreted, offer valuable diagnostic information. The neuro-otologist has been invited into this field of investigation because symptoms so frequently point to disturbance in the kinetic-static mechanism. Examination of the internal ear is decidedly incomplete if only the function of hearing is determined, since the kinetic-static portion deserves equal consideration. Rotatory and caloric tests give information on the behavior of the vestibular mechanism in much the same fashion as tuning forks and an audiometer enable one to determine the hearing. By familiarity with normal vestibular responses following artificial stimulation, together with an understanding of the anatomy and pathways concerned, deviations from normal are recognized and the seat of disturbance surmised and frequently localized. It should be emphasized that neurologic findings may be negative and the vestibular mechanism, including the pathways of the intracranial nerves, considerably damaged and deranged. For this reason every patient with injury to the head subjectively disturbed, particularly when consciousness has been lost, deserves vestibular investigation. Hearing tests are subjective and depend entirely on the intelligence, honesty and cooperation of the patient, whereas vestibular responses are objective and yield information concerning the internal ear and the vestibular apparatus in the brain over which the patient exercises little or no control. It is on the objective evidence of a deranged kinetic-static mechanism that diagnostic conclusions are made possible.

After the immediate and acute effects of injury to the head have subsided, after-effects begin to make their appearances, and it is with these that this paper is concerned. It is the rule for patients to attribute their symptoms directly to a specific accident.

Children, particularly below the age of 10 years, show little tendency to develop symptoms or sequelae, notwithstanding the severity of the accident or the occurrence of prolonged unconsciousness. One patient, a boy aged 6 years, was unconscious for twenty-one days after an automobile accident and at the time of writing, eleven months after his injury, has not offered any subjective complaints. Vestibular and auditory findings are normal. His brother, aged 11 years, was rendered unconscious for twenty-four hours in the same accident. He experienced two or three attacks of vomiting per week for the next six months. When last examined he complained of headache and dizziness, particularly on change of position, fell when the head was bent downward and staggered at times. It is of interest to note that this patient, five years older, unconscious for twenty-four hours in contrast to the twenty-one days of unconsciousness experienced by the other, presents symptoms and findings indicative of intracranial damage. Another, a boy aged 9, in an attempt to halt a runaway horse, was dragged for almost a city block, when the horse stumbled and fell on him. He was unconscious for an indefinite period. Except for a 14 per cent loss of hearing for the conversational range in the right ear, together with peripheral involvement of the seventh nerve on the same side, he shows no neuro-otologic disturbance. Generally, the older the patient the more evident the disturbed reactions, particularly after the age of 50. Age is one explanation for the disproportion between the severity of injury and the resulting symptomatic damage.

SYMPTOMS

While it is true that conclusions depend on the type and character of vestibular responses, a careful history of all subjective complaints is important. Symptoms vary, are frequently vague and may be changeable. It is impossible to determine their precise order of appearance, and while, as a rule, post-traumatic conditions have many symptoms in common, an attempt to place them in a diagnostic group, while generally informative, proved unconvincing. However, certain subjective complaints deserve special mention.

Headache —This is the most frequent subjective symptom and, like the next, vertigo, varies generously. Occipital pains are common.

Vertigo —This complaint rivals the first mentioned in variation and frequency and is commonly in combination with it. It is variously described, as, for instance, "falling to one side," "things moving before the eyes," "tremors," "a feeling of goneness," "unsteadiness," "pounding" or "a feeling of drunkenness." Vertigo in the sense that objects definitely revolve in fixed fashion is exceptional and when artificially induced bears little, if any, resemblance to the type of which the patient

complains. This fact deserves emphasis. Vertigo may be originated or intensified by change of position, such as from the stooping to the upright, quick motion of the head and lifting of heavy objects. When damage to the labyrinth is mild, attacks come on irregularly and may not appear until some time after the injury. Vertigo, when frequent, persistent and easily induced, is a most unfortunate symptom and, according to some, deserves greater financial compensation than complete loss of hearing in one ear. Vertigo which persists more or less unchanged for six to eight months offers a guarded prognosis, after twelve to fifteen months the outlook is discouraging and grave.

Fatigue and Weakness—Undue fatigue on slight or moderate physical effort is common. Many patients maintain that they are tired all the time. Insomnia is common. This may be interpreted as an expression of a diseased brain. Vasomotor instability is commonly observed.

Changes in Mentality and Personality—Attention is called to these by members of the patient's family, friends and the family physician, who state that something has come over the patient since his accident. Common complaints are lack of interest in conditions that previously engaged serious attention, inability to concentrate, faulty memory, shrinking interest in dress and personal habits, fear of crowds and general disinclination to return to the previous normal standard. Efficiency usually suffers, often so as to demand changes of occupation. It is not unreasonable to assume that the above symptoms, together with those mentioned in the previous paragraph, may have a common explanation.

Defects in Hearing—The complaint of disturbed hearing, particularly in one ear, is common. Tuning forks and an audiometer aid in the determination of type, location and extent of deafness. Unilateral perceptive involvement is by far the most common. When findings indicate disturbance in the conductive mechanism, improvement under treatment may follow, but when there is a loss of perception for notes in the upper part of the scale, the basal coil of the cochlea has been damaged, and little, if any, tendency to spontaneous recovery should be expected. While tuning forks are of value so far as the Weber, Rinne and Schwabach tests are concerned, the audiometer offers valuable information, since it is not uncommon that forks and the Galton whistle are heard well but when the hearing is checked with the audiometer, dips in the high register are noted.

PATHOLOGIC CHANGES

In order to interpret symptoms and findings a conception of the underlying pathologic changes is necessary. Because of the numerous

and various forms of trauma, the resulting pathologic changes and sequelae differ in type, degree and location. However, they possess much in common, and it is by the interpretation of this that a basis for conclusions is afforded. Injury to the labyrinth may be caused by an exudate into it. A more violent trauma may tear portions of the auditory and vestibular end organs. Sudden displacement of the brain stem by the impact may directly injure the eighth nerve as it enters the fallopian canal. Considerable research and experimental study of the pathologic changes resulting from injuries to the head were undertaken by Brunner,² Yoshii,³ Stenger⁴ and others. Their findings are reported at length in the literature. It was Brunner's conviction that as a result of injuries to the head in the human being degenerative changes occur in the nuclei of the cochlear and vestibular nerves. He showed also that the altered irritability of the vasodilators and vasoconstrictors causes localized areas of altered circulation. Traumatic paralysis of the vasoconstrictors is probably due to damage of the midbrain. Long-continued vasomotor changes produce cellular abnormalities which may finally terminate in areas of necrosis and formation of scar tissue. Direct damage may occur to the eighth nerve or the labyrinth itself, particularly when the petrous portion of the temporal bone is fractured. This aspect, however, is deliberately omitted. Experimental evidence emphasizes that the damage is not localized to the ear itself but that in every case of symptomatic injury to the head the brain, too, is injured. Brunner asserted that one can have concussion of the brain without concussion of the inner ear but cannot have concussion of the inner ear without concussion of the brain. In 1928 I¹ emphasized that findings indicated a combination of central and peripheral involvement. This is in accord with subsequent findings recorded by Linthicum and Rand,⁵ whose experiences indicated that in nearly all instances the vestibular symptoms following concussion are due to the combination of injury to the end organ and to the central nervous system. Experimentally, in animals, it has been shown that little relation exists between the severity of impact and the amount of damage resulting.

2 Brunner, H. Pathologie und Klinik der Erkrankungen des Innenohres nach Stumpfen Schädeltraumen, *Monatschrift für Ohrenheilkunde* **59** 697, 1925.

3 Yoshii, U. Experimental Study of Traumatic Injuries of the Ear, *Zentralblatt für Ohrenheilkunde* **9** 561, 1910-1911.

4 Stenger. Ueber die Arten der nach Kopfverletzungen auftretenden Neurosen. Die traumatische Labyrinthneurose, *Deutsche medizinische Wochenschrift* **31** 63, 1905.

5 Linthicum, F. H., and Rand, C. W. Neuro-Otological Observations in Concussion of the Brain, *Archives of Otolaryngology* **13** 785 (June) 1931.

DIAGNOSTIC DATA

An attempt was made at tabulation based on symptoms and findings in individual cases, but the data were found lengthy, complicated and confusing and served a relatively limited purpose. Instead, emphasis is placed on the most common and significant deviation offering diagnostic leads.

Examination depends on reactions that are (1) spontaneous or (2) artificially induced.

1 *Spontaneous Reactions*—(a) If nystagmus is present, its type and character are noted. Unless the patient is observed early, it is usually absent. If the labyrinth has been destroyed spontaneous nystagmus toward the sound side is noted immediately after the injury. It is amplified when the patient looks toward the healthy side. Intense vertigo and nausea are present, particularly when movements of the head occur. I have never encountered spontaneous vertical nystagmus either upward or downward resulting from injury to the head. An occasional upward twitch may be noted but should not be confounded with true nystagmus. It is questionable whether the direction of the nystagmus furnishes trustworthy information regarding the injured side. I am inclined to agree with Grove,⁶ who stated that the nystagmus is caused by a decompensation or imbalance between the two labyrinths.

(b) Past pointing is common, important and usually confined to pointing with one hand and may be inward or outward.

(c) The Romberg test and the pelvic girdle test show whether swaying or falling is present. Swaying is commonly observed after injury to the head. The direction in which the patient falls when the head is turned quickly to either side with the eyes closed is noted. Falling may give some inkling as to whether one is dealing with a central or a peripheral lesion. The sooner after the accident the test is applied, the greater its value.

2 *Artificially Induced Reactions*—These are brought about by (a) rotation in a revolving chair or (b) caloric stimulation (cold or warm solutions). It is on this portion of the test that greatest reliance is placed, particularly on the reaction to caloric stimulation. A fairly wide variety of abnormal responses is observed. Such responses may vary from time to time in the same patient, particularly in degree, but unless spontaneous recovery occurs within six to twelve months, the type of abnormal response persists, and even further degenerative change is apt to appear. The vertical canals or the horizontal canal may show delayed and impaired response after injury and when reexamined at a later time may show further impairment or complete loss of function.

⁶ Grove, W. E. Otolologic Observations in Trauma of the Head. Clinical Study Based on Forty-Two Cases, Arch Otolaryng 8:249 (Sept.) 1928.

(a) *Rotation in a Revolving Chair* If examination is made soon after the accident, a discrepancy between the after-turning nystagmus and vertigo on one or both sides may be noted. Later on responses may be normal, hypoactive or hyperactive and furnish relatively little valuable lasting information. However, it is interesting to observe the striking difference in response from the horizontal canals when reactions to turning are compared with those to caloric stimulation. The examiner is inclined to question whether the same mechanism is stimulated, since it is not uncommon to observe fairly good or normal postrotational horizontal nystagmus and impairment or absence of nystagmus following caloric stimulation.

Past pointing may be present with one or both arms, normal with one and crossed with the other. Perverted past pointing should be regarded as significant. Nystagmus may be good, even hyperactive in amplitude and duration after stimulation and past pointing absent.

As previously mentioned, the type of spontaneous vertigo resembles little if at all that which is experienced after rotation. Shortened post-rotational vertigo is common.

(b) *Caloric Stimulation* Examples of a few of the most common findings are reviewed (roentgen evidence negative for fracture of the skull, results of neurologic examination negative for organic pathologic change).

Normal responses from all canals on one side with absence of responses from all canals on the opposite side.

CASE OF C L—A man aged 51 fell down stairs in April 1937, striking the back of the head. He was unconscious for two or three hours and was removed to a hospital, where he remained four or five days. The chief complaints were headache, dizzy spells (falling to the left, particularly on stooping and other change of position), impaired hearing in the left ear, easily induced fatigue, changes in personality ("wants to be left alone and not bothered") and inability to sleep unless sitting up in a chair. Vestibular examination was performed twenty months after the accident.

Spontaneous Reactions—Nystagmus was absent when the patient was looking straight ahead, to the extreme right or left, upward or downward. The Romberg test showed slight swaying. When the patient was standing with the heels and toes approximated and the eyes closed there was a tendency to fall toward the left when the head was suddenly turned to the right and then to the left. Movements of the pelvic girdle were fair. Past pointing was absent with each arm.

Artificially Induced Reactions—*Turning Test* On turning to the right, ten turns in twenty seconds, the patient exhibited horizontal nystagmus to the left of poor amplitude and ten seconds' duration and vertigo of thirteen seconds' duration. Past pointing occurred, 4 inches (10 cm) to the right, with the right arm and was absent with the left. On turning to the left, the patient exhibited horizontal nystagmus to the right of fair amplitude and twelve seconds' duration and vertigo of seven seconds' duration. Past pointing was absent with each arm.

Caloric Test (68 F) After fifty seconds' stimulation of the right ear, with the head erect, rotary nystagmus to the left was observed with good amplitude.

Past pointing occurred, 4 inches (10 cm) to the right with each arm. When the head was tilted back horizontal nystagmus to the left was observed with good amplitude. With the head in this position past pointing occurred, 4 inches (10 cm) to the right with each arm. When the left ear was similarly tested a response was not observed from the vertical canals or the horizontal canal after four minutes of stimulation. Past pointing was absent with each arm.

Conversational hearing was tested separately in each ear when the ears were separately irrigated during the caloric test and found good on both sides. Since the patient was not affected by the tests, they were all performed at a single sitting.

Neurologic Report—"There seems to be little in the way of objective symptoms. Signs of a cerebellar defect are not present. The condition resembles post-traumatic neurosis. Further observation is necessary."

Notwithstanding the absence of responses to caloric stimulation on the left side, conversational hearing is good in that ear.

Normal responses from all canals on one side with delay and impairment of responses from the vertical canals and absence of response from the horizontal canal on the opposite side.

CASE OF G. M.—A man aged 37, an iron worker, in June 1937, while at work, was suddenly raised in the air by a cable to an unknown height and on releasing himself fell on his head. He was unconscious the first four days during his hospitalization of twenty-five days. The chief complaints were vertigo, particularly on turning the head and stooping, impairment of hearing in the left ear, constant noises in the left ear, changes in personality, a feeling of limpness and occasional staggering to either side necessitating "holding on to something to support himself." Vestibular examination was performed nineteen months after the accident.

Spontaneous Reactions—Nystagmus was absent except for a few twitches on looking upward. The Romberg test showed swaying. On turning the head first to the right and then to the left, swaying occurred. Movements of the pelvic girdle were fairly good. Past pointing was absent with each arm. Unsteadiness was noted in each arm.

Artificially Induced Reactions—**Turning Test**. On turning to the right, the patient had horizontal nystagmus to the left of fair amplitude and eight seconds' duration and vertigo of twenty-four seconds' duration. Past pointing was absent with each arm. On turning to the left, the patient exhibited horizontal nystagmus to the right of good amplitude and seventeen seconds' duration and vertigo of twenty-six seconds' duration. Past pointing was absent with each arm.

Caloric Test. After fifty seconds' stimulation of the right ear, with the head erect, a rotary nystagmus to the left was observed with fair amplitude. Past pointing occurred, 2 inches (5 cm) to the right, with the right arm but was absent with the left. When the head was tilted back horizontal nystagmus to the left was observed, with large amplitude. With the head in this position past pointing occurred, 2 inches (5 cm) to the right, with the right arm but was absent with the left. When the left ear was similarly tested rotary nystagmus to the right appeared after one minute and five seconds, with poor amplitude. Past pointing was absent with each arm. When the head was tilted back there was no response from the left horizontal canal. Past pointing was absent with each arm.

Conversational hearing was found impaired in the left ear and good in the right. Since the patient was not affected by the tests they were all performed at a single sitting.

The audiogram showed a sharp dip in the threshold of the left ear from 512 double vibrations (15 decibels) to 1024 (50 decibels) and 2048 (65 decibels)

Absence of responses from all canals on one side with absence of responses from the vertical canals on the opposite side and a normal or subnormal response from the horizontal canal (a syndrome similar to that with tumor of the cerebellopontile angle) I¹ called attention to this finding in 1928 in a report before the Philadelphia Laryngological Society. It has been repeatedly observed and mentioned in the literature since and may perhaps be considered, when present, the most significant syndrome symptomatic of post-traumatic cerebral damage. Linnicum and Rand⁵ mentioned my reported case and reported 6 such cases of their own. The differentiation of the condition from tumor of the angle is not difficult, since tumor of the angle has a delayed onset with tinnitus, hearing and vestibular responses are either impaired or absent on the side of involvement and the opposite vertical canals are nonresponsive, while the horizontal canal is active and commonly exhibits an active, perverted response. If added to this vertical nystagmus, papilledema, or choked disk, peripheral involvement of the seventh nerve and absence of corneal reflex on the same side are present, the diagnosis of tumor of the angle is definite.

CASE OF W. C.—A man aged 32, a carpenter, in June 1925 while riding in his automobile, was struck by a trolley car. He was rendered unconscious and removed to a hospital. He remained unconscious for three days, during which he vomited frequently. He was hospitalized for eighteen days. On regaining consciousness he complained of total loss of hearing, vertigo and staggering. Vestibular examination was performed six months after the accident.

Spontaneous Reactions—On the patient's looking to the right there was horizontal nystagmus to the right, on his looking to the left there was horizontal nystagmus to the left, on his looking upward or downward nystagmus was absent. The Romberg test was negative. Turning the head first to the right and then to the left did not produce any effect. Movements of the pelvic girdle were good. Past pointing was absent with each arm.

Artificially Induced Reactions—**Turning Test** On turning to the right the patient exhibited horizontal nystagmus to the left of fair amplitude, eleven seconds' duration and vertigo of thirteen seconds' duration. Past pointing occurred, 3 inches (8 cm) to the right with the right arm and 2 inches (5 cm) to the right with the left arm. On turning to the left the patient exhibited horizontal nystagmus to the right of fair amplitude and eleven seconds' duration and vertigo of ten seconds' duration. Past pointing occurred, 4 inches (10 cm) to the left, with the right arm but was absent with the left arm.

Caloric Test After four minutes' stimulation of the right ear, with the head erect, the right vertical canals did not show any response. Past pointing was absent with each arm. When the head was tilted back there was no response from the right horizontal canal. Past pointing was absent with each arm. When the left ear was similarly tested the left vertical canals showed no response after four minutes. Past pointing was absent with each arm. When the head was

tilted back horizontal nystagmus to the right was observed with fair amplitude. Past pointing occurred, 4 inches (10 cm) to the left with each arm.

Conversational hearing was absent in both ears. Since the patient was not affected by the tests, they were all performed at a single sitting.

Audiogram—The right ear was totally deaf to all sounds from C (64 double vibrations) to c-6 (8192 double vibrations). Observations on the left ear were identical with those on the right except that with the dial at approximately 85, c-2 (512 double vibrations) was definitely and unmistakably heard. This represents a 68 per cent loss of hearing for this single remnant.

Eight patients in the series presented this syndrome. Hearing may be impaired or absent on one or both sides. The single canal to react is the horizontal, from which the nystagmus may be good, fair or poor and either horizontal or perverted.

Absence of responses from the vertical canals on each side and a perverted response from the horizontal canal on each side, with acute hearing in both ears for the conversational range. Beyond this frequency, particularly in the upper limits, dips are common.

CASE OF J. J.—A man aged 27, a steel worker, fell from a six story height down an elevator shaft, October 1936. He stated that he was unconscious for two or three minutes. He was hospitalized for eight days. His chief complaints were severe headaches, dizziness, particularly on stooping, insomnia, loss of weight and fatigability. Vestibular examination was performed two years after the accident.

Spontaneous Reactions—Nystagmus was absent. The Romberg test was negative. Turning the head first to the right and then to the left did not produce any effect. Movements of the pelvic girdle were good. Past pointing occurred, 6 inches (15 cm) to the right, with the right arm but was absent with the left.

Artificially Induced Reactions—Turning Test. On turning to the right the patient exhibited horizontal nystagmus to the left of good amplitude and twenty-six seconds' duration and vertigo of twenty-eight seconds' duration. Past pointing occurred, 10 inches (25 cm) to the right, with the right arm but was absent with the left. On turning to the left the patient exhibited horizontal nystagmus to the right of good amplitude and twenty-six seconds' duration and vertigo of twenty-six seconds' duration. Past pointing occurred, 6 inches (15 cm) to the left with each arm.

Caloric Test. After four minutes' stimulation of the right ear, with the head erect, the right vertical canals showed no response. Past pointing occurred 4 inches (10 cm) to the left, with the right arm but was absent with the left. When the head was tilted back perverted (oblique) nystagmus to the left was observed with fair amplitude. Past pointing was absent with each arm. When the left ear was similarly tested the left vertical canals showed no response after four minutes. Past pointing was absent with each arm. When the head was tilted back perverted (oblique) nystagmus to the right was observed, with poor amplitude. Past pointing was absent with each arm.

Conversational hearing was acute in both ears. All tests were performed at a single setting, although the patient felt drunk and was slightly nauseated (?).

Conversational hearing was acute in both ears. When tested with the audiometer, the hearing was noted to be good throughout the

entire scale. It is interesting to note that the response from the vertical canals on each side was absent, while that from the horizontal canal on each side was perverted.

Absence of response from the vertical canals on each side and a perverted response from the horizontal canal on each side, with impaired hearing in both ears.

CASE OF J. R.—A man aged 60 tripped over an iron pipe in September 1938, striking the head against a sidewalk. An indefinite short loss of consciousness followed. He was removed to a hospital but refused to remain for treatment beyond emergency measures. His chief complaints were impairment of hearing in both ears (he stated that prior to the accident he could hear a clock ticking in the next room), headache, vertigo and confusion. Vestibular examination was performed three months after the accident.

Spontaneous Reactions—Nystagmus was absent. The Romberg test was negative. Turning the head first to the right and then to the left did not produce any effect. Movements of the pelvic girdle were good. Past pointing was absent with the right arm but occurred, 4 inches (10 cm) to the left, with the left arm.

Artificially Induced Reactions—Turning Test. On turning to the right the patient exhibited horizontal nystagmus to the left of good amplitude and seventeen seconds' duration and vertigo of twelve seconds' duration. Past pointing occurred, 8 inches (20 cm) to the right, with the right arm but was absent with the left. On turning to the left the patient exhibited horizontal nystagmus to the right of fair amplitude and sixteen seconds' duration and vertigo of twelve seconds' duration. Past pointing was absent with the right arm but occurred, 8 inches (20 cm) to the left, with the left arm.

Caloric Test. After four minutes' stimulation of the right ear, with the head erect, the right vertical canals showed no response. Past pointing was absent with each arm. When the head was tilted back perverted (oblique) nystagmus to the left was observed with fair amplitude. Past pointing was absent with each arm. When the left ear was similarly tested the left vertical canals showed no response after four minutes. Past pointing was absent with each arm. When the head was tilted back perverted (oblique) nystagmus to the right was observed, with fair amplitude. Past pointing was absent with each arm.

Conversational hearing was impaired in both ears. Since the patient was not affected by the tests, they were all performed at a single sitting.

Caloric responses were more or less identical with those in the case of J. J. except for the bilateral impairment of hearing of the perceptive type. There was a sharp dip in the audiogram in both ears beyond the frequency 2896.

Absence of response from the vertical canals on one side with a perverted response from the horizontal canal on the opposite side.

CASE OF J. H.—A youth aged 18, a sheet metal worker, was rendered unconscious for an unknown period in October 1938, when a trolley car jammed into the automobile in which he was riding. He was taken to a hospital and according to his own statement was dazed for several hours immediately after the accident. He remained in the hospital for eight days. His chief complaints were "thumping on the top of the head," headaches, dizziness, changes in personality, deafness in

the left ear and the loss of 21 pounds (9.5 Kg) in the three months after the accident. He stated that his hearing was perfect prior to the accident and that none of the foregoing symptoms was ever present. Vestibular examination was performed five months after the accident.

Spontaneous Reactions—Nystagmus was absent. The Romberg test was negative. Turning the head first to the right and then to the left did not produce an effect. Movements of the pelvic girdle were good. Past pointing was absent with each arm.

Artificially Induced Reactions—Turning Test. On turning to the right the patient exhibited horizontal nystagmus to the left of small amplitude and two seconds' duration and vertigo of nine seconds' duration. Past pointing occurred, 4 inches (10 cm) to the left, with the right arm but was absent with the left. On turning to the left the patient exhibited horizontal nystagmus to the right of poor amplitude and six seconds' duration and vertigo of fifteen seconds' duration. Past pointing occurred, 2 inches (3 cm) to the left, with the right arm but was absent with the left.

Caloric Test. After four minutes' stimulation of the right ear, with the head erect, the right vertical canals showed no response. Past pointing was absent with each arm. When the head was tilted back horizontal nystagmus to the left was observed, of poor amplitude. Past pointing was absent with each arm. When the left ear was similarly tested the left vertical canals produced a rotary response to the right after one minute and fifteen seconds, with fair amplitude. Past pointing was absent with the right arm but occurred, 4 inches (10 cm) to the right, with the left arm. When the head was tilted back rotary (perverted) nystagmus to the right was observed, with good amplitude. Past pointing was absent with each arm.

Conversational hearing was found absent in the left ear but acute in the right ear. Since the patient was not affected by the tests they were all performed at a single sitting.

Audiogram—The left ear showed 51 per cent loss of hearing, the right ear did not show any loss of hearing for the conversational range.

Caloric stimulation on the right side was followed by no response in the right vertical canals with a poor response in the right horizontal canal, notwithstanding acute hearing in that ear. On the left side the vertical canals were hypoactive, while the left horizontal canal showed good but perverted (rotary) response. Conversational hearing was absent on that side.

Absence of response from the vertical canals on one side and a perverted response from the horizontal canal on the same side, with good conversational hearing on this side.

CASE OF W. M.—A man aged 25, a cabinet maker, in January 1931, while driving his automobile, was struck by a trolley car and rendered unconscious for several hours. When consciousness was regained he was in a hospital. A bloody discharge from the left ear was present for several days. His chief complaints were headaches, vertigo, confusion, tinnitus and impaired hearing in the left ear. Vestibular examination was performed thirteen months after the accident.

Spontaneous Reactions—Nystagmus was absent except for a few twitches on looking upward. The Romberg test was negative. Turning the head first to the

right and then to the left did not produce any effect. Movements of the pelvic girdle were absent. Past pointing was absent with each arm.

Artificially Induced Reactions—Turning Test. On turning to the right the patient exhibited horizontal nystagmus to the left of good amplitude and twenty-four seconds' duration and vertigo of ten seconds' duration. Past pointing occurred 4 inches (10 cm) to the right with each arm. On turning to the left the patient exhibited horizontal nystagmus to the right of good amplitude and twenty seconds' duration and vertigo of fifteen seconds' duration. Past pointing occurred 4 inches (10 cm) to the left with each arm.

Caloric Test. After three minutes' stimulation of the right ear with the head erect the right vertical canals showed no response. Past pointing was absent with each arm. When the head was tilted back perverted (oblique) nystagmus to the left was observed rapid with small amplitude. Past pointing occurred, 6 inches (15 cm) to the right with the right arm and 6 inches (15 cm) to the left with the left arm. When the left ear was similarly tested the left vertical canals produced rotary nystagmus to the right after two minutes with small amplitude. Past pointing was absent with the right arm but occurred 6 inches (15 cm) to the left with the left arm. When the head was tilted back, rotary (perverted) nystagmus to the right was observed rapid with small amplitude. Past pointing was absent with the right arm but occurred 6 inches (15 cm) to the left with the left arm.

Conversational hearing was absent in the left ear and acute in the right ear. Although the patient showed a slight tendency to perspire and was slightly nauseated all the tests were performed at a single sitting.

There was a perverted response from the horizontal canal on each side. On the side of acute conversational hearing the response from the vertical canals was absent while the response from the horizontal canal was perverted (oblique). On the nonhearing (conversational) side the vertical canals responded poorly, while there was a rotary (perverted) response from the horizontal canal.

Conversational hearing may be acute, impaired or absent on the same side as, or the side opposite to, abnormal responses from the semicircular canals. Changes in the upper frequency range are common.

The foregoing illustrations are representative of a few combinations of disturbed reactions. The examiner is impressed by the inconstancy of findings and the variety of combinations that may follow symptomatic injury to the head.

ADDITIONAL OBSERVATIONS

Injury to the Cranial Nerves—Except for disturbed function observed in the cochlear and the vestibular portion of the eighth nerve the cranial nerves are rarely involved unless the condition is complicated by fracture of the skull.

Constitutional Reactions—When the ears of a normal person are doused with cold water (68 F) for forty to sixty seconds evidences of susceptibility to vestibular stimulation appear as pallor, perspiration, nausea and at times vomiting. The absence of sensitivity after pro-

longed douching, particularly when active nystagmus has been induced, offers valuable evidence in favor of intracranial involvement. As a rule, diminution or absence of susceptibility to tests is noted in cases of symptomatic injury to the head.

CONCLUSIONS

Every patient with injury to the head subjectively disturbed should be examined neuro-otologically as soon after injury as possible and reexamined occasionally for approximately one year to determine the integrity of the kinetic-static and the auditory mechanism.

While a definite objective syndrome is not produced, vestibular tests are of inestimable value in offering a possible explanation for subjective symptomatic complaints.

Headaches and disturbances of equilibrium following injury to the head, if persistent, show derangement of the kinetic-static mechanism.

Concussion of the inner ear and brain result from the same force, producing evidences of combined central and peripheral involvement, the extent of which is not always in direct proportion to the force or type of trauma.

Vestibular abnormalities offer an organic explanation for many so-called functional disturbances.

Findings similar to those with tumor of the cerebellopontile angle, when present, are significant. They occur in a fairly large percentage of cases.

Persons suffering from symptomatic post-traumatic conditions of the head deserve financial compensation commensurate with their physical handicap.

A plea is made for closer cooperation between the family physician, the industrial surgeon, the neurologist and the neuro-otologist.

Findings, symptoms and sequelae help to clarify a clinical condition far too important to neglect or ignore.

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CARCINOMA OF THE TRACHEA

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In recent years, several discussions of primary carcinoma of the trachea have appeared in the literature. Notable among these are the reviews of Culp,¹ Leroux-Robert,² Baratoux,³ Tiling,⁴ Dumas and Guichard⁵ and D'Aunoy and Zoeller.⁶ With the exception of Baratoux, these reviewers have dealt primarily with the morphologic character of the tumor, and the clinical and therapeutic aspects have been touched on only briefly or have been ignored. In the great majority of the cases reported the diagnosis was established at necropsy. This is particularly true of the earlier cases. Hence, it is not surprising that most of the reports consist primarily of pathologic data. Since bronchoscopic examination has come to be recognized as a valuable diagnostic procedure, discovery of primary intratracheal neoplasms during the life of the patient is no longer uncommon.

It is the purpose of this discussion to attempt to correlate the pathologic findings with the symptoms and treatment in cases of carcinoma of the trachea. Sixteen cases of primary carcinoma of the trachea encountered at the Mayo Clinic since 1921 will be reviewed. Of these 16 cases 5 have been previously reported by Figi,⁷ 1 by Guttman⁸ and

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2 Leroux-Robert, J. Les cancers primitifs de la trachée. Étude anatomopathologique (à propos d'un cas d'épithélioma prostradiothérapique de la trachée chez une basedowienne), *Ann d'oto-laryng*, May 1936, pp 493-521

3 Baratoux, J E. Tumeurs malignes primitives de la trachée, *Ann d'oto-laryng*, November 1933, pp 1272-1289

4 Tiling, W. Ueber Trachealcarcinome im Anschluss an einem Fall von Basalzellen Carcinom, *Monatschr f Ohrenh* **67** 322-347 (March) 1933

5 Dumas, A, and Guichard, A. Cancer primitif de la trachée, *Lyon méd* **148** 642-646 (Nov 29) 1931

6 D'Aunoy, R, and Zoeller, A. Primary Tumors of the Trachea. Report of a Case and Review of the Literature, *Arch Path* **11** 589-600 (April) 1931

7 Figi, F A. Primary Carcinoma of the Trachea, *Arch Otolaryng* **12** 446-456 (Oct) 1930

8 Guttman, M R. Primary Adenocystic Carcinoma or Cylindroma of the Trachea, *Ann Otol, Rhin & Laryng* **45** 894-901 (Sept) 1936

1 by Vinson and Leddy.⁹ Nine have not been previously reported. Of the 16 cases, the correct diagnosis was made during the life of the patient in 15. In the remaining case, autopsy performed elsewhere disclosed that the patient had been suffering from an annular carcinoma situated just below the vocal cords.

Specimens for biopsy were taken from the 15 patients by surgical or endoscopic means, and this material has been available for microscopic study. Histologically the 15 tumors can be divided into two general classes: first, those which arise from cells normally lining the trachea and which for purposes of clarity will be considered as adenocarcinomas and, second, those which distinctly were squamous cell epitheliomas. Of the specimens obtained from 15 patients, 9 were adenocarcinomas and 6 were squamous cell epitheliomas. The grading system of Broders¹⁰ was used in each case. Grade 1 indicates a low degree of malignancy, grade 4, a high degree.

Differentiation of cells forms the underlying principle on which the carcinomas are graded. Thus, grade 1 signifies a neoplasm in which at least 75 per cent of the cells are differentiated. Grades 2, 3 and 4 have 50 to 75 per cent, 25 to 50 per cent and 0 to 25 per cent respectively of differentiated cells.

HISTOGENESIS

Present day theories of the development of epithelial tumors are based on the conception of the universal basal or germinal cell layer. Applied to the respiratory system, these views are well summarized by Fried.¹¹ It has long been known (Ribbert¹²) that neoplasms are derived from undifferentiated cells. Hence, the ciliated columnar cells of the tracheobronchial tree are incapable in themselves of producing tumors. It is thought that the basal cells of all epithelial surfaces are undifferentiated and that they are essentially similar throughout the body. They are capable of regenerative power and reproduce cells which are characteristic of the epithelium in which they are situated. When that unknown factor appears which removes the normal restraint on the production of cells, a tumor results, comprised of cells derived from the germinal layer. In a structure such as the trachea or a bronchus, the basal layer gives rise to surface epithelial (ciliated columnar) cells, goblet cells and the serous or mucous cells of the glandular structures in the lamina propria.

9 Vinson, P. P., and Leddy, E. T. Cancer of the Trachea, Proc. Staff Meet., Mayo Clin. **8** 641-643 (Oct. 25) 1933.

10 Broders, A. C. The Grading of Carcinoma, Minnesota Med. **8** 726-730 (Dec.) 1925.

11 Fried, B. M. Primary Carcinoma of the Lung. Bronchiogenic Cancer—A Clinical and Pathological Study, Medicine **10** 373-508 (Dec.) 1931.

12 Cited by Fried.¹¹

Hence, epithelial tumors of the trachea may contain any or all of these cell types or may consist of a reproduction of the basal cells. Likewise, as these basal cells are embryonic and generative, they are capable of giving rise to squamous cells. This last point has been emphasized by such authorities as Boist¹² and Krompecher¹³ and has provided the best explanation for "metaplasia." Because "metaplasia" would indicate the transformation of one cell type into another, the term is being discarded in favor of the expression "protoplasia," which correctly indicates the germinal cell origin of the altered epithelium.

Thus, the original conception of Virchow¹² concerning metaplasia of one type of cell into another is no longer tenable. Also, the hypothesis of Cohnheim,¹² according to which cell enclavements or nests of cells are held responsible for the presence of squamous epithelium on visceral linings, is considerably less valid. Of interest in this connection are the studies of Wolbach and Howe,¹⁴ who were able to demonstrate the keratinization of epithelial surfaces in animals deprived of fat-soluble vitamin A. The significance of this widespread keratinization is not understood. It has been repeatedly observed that chronic infections of the lung, pneumonia, influenza and whooping cough are accompanied by protoplasia of columnar to squamous epithelium. It is likewise asserted that malignant neoplasms are likely to develop where "metaplasia" has taken place, and this, of course, lends support to the concept that carcinoma develops at the site of a previous irritation (Virchow)—that is, where regenerative processes are taking place.

HISTORICAL ASPECTS

In 1767, Lieutaud¹⁵ described the first tumor of the trachea discovered at autopsy. The character of the tumor was not mentioned. In 1857, Rokitsansky¹⁵ described the gross appearance of a carcinoma of the trachea. In 1861, Turck¹⁵ reported a tracheal tumor which he had seen with a laryngeal mirror. In 1871, both Langhans¹⁶ and Schroetter¹⁵ described malignant tumors of the trachea and presented histologic findings. In 1897, Killian¹⁵ observed a tracheal tumor with his bronchoscope.

Reviewers have stressed the rarity of tracheal tumors. Schmidt¹⁵ reported that in 42,635 cases there were 2,088 tumors of the upper

13 Krompecher, E. Zur Kenntnis der Basalzellerkrebse der Nase, der Nebenhöhlen, des Kehlkopfes und der Trachea, *Arch f Laryng u Rhin* **31** 443-460, 1918, Ueber Gesetzmässigkeiten im Aufbau der Krebse, *Ztschr f Krebsforsch* **22** 410-421 (Aug.) 1925.

14 Wolbach, S. B., and Howe, P. R. Vitamin A Deficiency in the Guinea-Pig, *Arch Path* **5** 239-253 (Feb.) 1928.

15 Cited by Baratoux.³

16 Cited by Leroux-Robert.²

an passages, 748 tumors of the larynx and only 3 tumors of the trachea. In 1908, Chiari¹⁵ stated that of 140,000 patients seen, 1,329 had tumors of the larynx and 9 had tumors of the trachea. The autopsy records of some of the largest hospitals in the world reveal the occurrence of only 1 or 2 tracheal tumors among thousands of cadavers examined. A summary of the figures presented shows that the ratio of laryngeal to tracheal tumors is about 100 to 1. The rarity of tumors of the trachea has been explained¹⁷ by the simple structure, immobility and passive function of the organ.

STATISTICAL DATA

In a recent paper on carcinoma of the trachea, Culp¹ stated that there are 433 recorded instances of tracheal tumor. One hundred and forty-seven of the tumors were designated as carcinomas. In evaluating this group of 147 carcinomas, he found that accurate histologic findings were described in only 82 instances. Since Culp's review, 4 additional case reports have appeared in the literature, those of Keeney¹⁸ (adenocarcinoma), Rathbone¹⁹ (basal cell carcinoma), Gotô and Kyo²⁰ (basal cell carcinoma) and Robin and Mann²¹ (squamous cell carcinoma). The 9 previously unreported cases from the Mayo Clinic are included in this paper. There is a total, therefore, of 95 carcinomas of the trachea which have been described histologically. Of these 95 tumors, 42 were squamous cell carcinomas, 43 were adenocarcinomas and 10 were basal cell carcinomas.

In the cases collected from the literature the degree of malignancy of the tumors was not indicated. In the series of 15 cases reported from the Mayo Clinic the neoplasms were graded according to the system designated in table 1.

In this paper, emphasis has been placed on the histologic differentiation and the degree of malignancy of the carcinomas involved. It is apparent that these factors are of prime importance in evaluating the efficacy of therapy. It is to be noted that adenocarcinoma and squamous cell carcinoma of the trachea occur with almost equal frequency.

17 Chevallier, R. Cancer primitif de la trachée a debut dysphagique, *Lyon med* **146** 309-315 (Sept 14) 1930.

18 Keeney, E. L. Primary Carcinoma of the Trachea with Cutaneous Carcinomatosis, *Bull Johns Hopkins Hosp* **61** 411-420 (Dec) 1937.

19 Rathbone, R. R. Primary Carcinoma of the Trachea. *Rev Tumor Therapy* **1** 66-68 (Aug) 1937.

20 Gotô, J., and Kyo, K. Ein Fall von Basalzellenkrebs, dessen Ursache in ueber jahrigem Gebrauch der Trachealkanuele zu liegen scheint, *Taiwan Igakkai Zasshi* **35** 1469 (July) 1936.

21 Robin, I. G., and Mann, W. N. Carcinoma of the Trachea. Commentary on a Case, *Guy's Hosp Rep* **87** 318-331 (July) 1937.

SITUATION OF THE TUMORS

The data on the situation of tracheal carcinomas have been well summarized by both Culp¹ and Baratoux.³ About half of all tumors considered by these authors were situated in the lower third of the trachea, about 35 per cent in the upper third and the remaining 15 per cent in the middle third. More than half of the tumors were situated on the posterior wall of the trachea. The remaining tumors developed on the anterior or lateral walls, were annular or partially encircled the trachea.

An analysis of the series studied at the Mayo Clinic, which includes 1 case in which autopsy was done elsewhere, shows that of the 16 cases the tumors were located in the upper third of the trachea in 5, in the middle third in 3 and in the lower third in 6 instances. In 1 instance the tumors were multiple and were dispersed throughout the trachea. In the remaining instance both the middle and the lower third of the

TABLE 1—*Grade and Type of Lesion in Fifteen Patients with Carcinoma of the Trachea at the Mayo Clinic*

Grade	Adenocarcinoma	Squamous Cell Carcinoma	Total
1	5	1	
2	1	1	
3	1	2	
4	2	2	
	<hr/>	<hr/>	<hr/>
Total	9	6	15

trachea were involved. The posterior and lateral walls of the trachea were involved jointly in 5 instances. The lateral walls only were the site of tumor masses in 5 instances. Joint involvement of the anterior and lateral walls of the trachea afflicted 2 patients. Two annular tumors and 1 tumor situated entirely in the anterior wall of the trachea were encountered.

While the figures thus evolved at the Mayo Clinic are not of statistical value by themselves, they tend to substantiate the conclusions of previous reviewers as to the site of the lesions. Briefly, carcinoma of the trachea occurs most frequently in the lower third of the trachea and on the posterior and lateral walls and least often in the middle third and on the anterior walls.

Various explanations have been given for this localization of tumors. Simmel²² and also Teuber²³ have stated the opinion that the region

22 Simmel, E. Zur Kasuistik des primären Carcinomas der Trachea, Arch. f. Laryng. u. Rhin. **24** 449-453, 1910.

23 Teuber, K. H. Das primäre Carcinom der Trachea, Ztschr. f. Hals-, Nasen- u. Ohrenh. **33** 444-458, 1933.

of bifurcation of the trachea is most exposed to trauma and hence is more subject to the formation of a tumor. The middle portion of the structure is immobile and is not subject to the irritations affecting the upper and the lower part. The predilection of the tumor for the posterior wall is explained by the rich glandular structure of this part of the trachea. Strauss²⁴ has demonstrated that lymph channels encircle the trachea between the cartilaginous rings and provide for drainage to the posterior wall, where lymph trunks form and accompany the recurrent laryngeal nerves. Likewise, Strauss showed that the number of lymph vessels is much greater in the inferior portion of the trachea. Furthermore, the cartilaginous rings offer successive lines of resistance against the lymphatic spread of infections or neoplastic processes up or down the trachea.

PERITRACHEAL INVOLVEMENT AND METASTASES

The subject of metastasis of tracheal carcinoma has been disputed. Stenn²⁵ stated that metastasis occurs in about 50 per cent of cases, while Robin and Mann²¹ have maintained that metastasis even to the neighboring lymph glands is rare. Simpson and Moore²⁶ noted the occurrence of metastases in 17 of the 27 cases of carcinoma of the lower part of the trachea collected by them.

The presence or absence of metastasis was noted by Culp¹ in 91 cases. Extension of the tumor beyond the limits of the trachea was specified in 62 and denied in 29 cases. The overwhelming proportion of such metastases occurred in the neighboring lymph nodes. Breslich²⁷ stated that the order of frequency of metastases is as follows: peritracheal, cervical and tracheobronchial lymph nodes, lungs, liver, supraclavicular and axillary nodes, esophagus, spleen, pancreas, kidneys and skeletal structures. Breslich's observation agrees well with the observations of Baratoux,³ Broman,²⁸ Stenn²⁵ and Simpson and Moore²⁶. Direct invasion is the most frequent and most important method of metastasis. Involvement of the anterior wall of the esophagus is common, and dysphagia is often the first symptom of the disease. Involvement

24 Strauss, J. F. The Intimate Lymphatics of the Trachea, *Ann Otol, Rhin & Laryng* **31** 715-737 (Sept.) 1922.

25 Stenn, F. Carcinoma of the Trachea. Review of Recent Literature and Report of a Case, *Arch Otolaryng* **21** 190-198 (Feb.) 1935.

26 Simpson, W. L., and Moore, R. M. Primary Colloid Adenocarcinoma of the Lower Third of the Trachea, *Ann Otol, Rhin & Laryng* **43** 1133-1138 (Dec.) 1934.

27 Breslich, P. J. Squamous Cell Carcinoma of the Trachea, *J. Cancer Research* **14** 144-151 (March) 1930.

28 Broman, J. R. Primary Carcinoma of the Trachea, with Report of a Case and Review of the Literature, *J. Cancer Research* **8** 394-408 (Oct.) 1924.

ment of the adjacent lymph nodes is of particular interest in view of the lymphatic drainage of the trachea. As has been noted, the lymphatic vessels follow the recurrent laryngeal nerves. Hence, lesions situated near the bifurcation of the trachea with involvement of the mediastinal lymph nodes may result in compression of the left recurrent laryngeal nerve and paralysis of the left vocal cords. Lesions situated high in the trachea may metastasize to the cervical nodes and may compress both recurrent laryngeal nerves, producing bilateral palsy of the vocal cords.

Distant metastases resulting from carcinoma of the trachea are not common. One patient in our series suffered from a metastatic mass situated in the left frontal region. Keeney¹⁸ recently reported a case in which the patient had widespread cutaneous metastases. Of Fraenkel's²⁹ 8 subjects examined at autopsy, 1 had pancreatic metastasis, another had splenic metastasis and a third had skeletal metastasis.

Instances of involvement of the tracheal cartilages are unusual. Such instances have been reported, however, by Stenn²⁵ and by Robin and Mann.²¹

AGE AND SEX INCIDENCE

Of 116 patients with carcinoma of the trachea whose age and sex were given, the lesion occurred in 100 between 30 and 70 years of age, and the incidence was approximately equal in each of the four decades represented. Seventy-three of the 116 patients were males and 43 were females. This distribution in age is in approximate agreement with the ratio of 2 to 1 expressed by several observers. Robin and Mann's²¹ ratio was 2 to 1, D'Aunoy and Zoeller's⁶ ratio was 2.3 to 1, and Broman's²⁸ ratio was 1.6 to 1.

In the series studied at the Mayo Clinic there were 9 females and 7 males, and the ages ranged from 29 to 77.

SYMPTOMS

The symptoms of carcinoma of the trachea are caused chiefly by the action of a group of mechanical factors. This fact has been stressed in a recent paper on tumors of the trachea by Jackson.³⁰ The most common and the most urgent complaint of the patient with a tracheal tumor is shortness of breath. Dyspnea occurs because the tracheal lumen is invaded by the growth. This particular type of dyspnea is similar to that caused by any lesion that obstructs the upper air passages. Such

29 Fraenkel, E. Ueber Luftrohrenkrebs, *Deutsches Arch f klin Med* **135** 184-207 (Feb) 1921.

30 Jackson, C. Tumors of the Trachea, *South Surgeon* **5** 263-276 (Aug) 1936.

a type of obstructive dyspnea causes an easily recognizable stridor like that caused by a laryngeal lesion or an aspirated foreign body Vinson³¹ stated that lesions of the larger bronchi likewise cause stridor

Dyspnea which is the result of tracheal tumors is frequently paroxysmal and occurs most often at night or when the patient lies down The degree and nature of the dyspnea depend on the size and location of the lesion Pedunculated tumors may be responsible for respiratory difficulty which may be either chiefly inspiratory or chiefly expiratory Inspiratory obstruction tends to produce pulmonary atelectasis Expiratory obstruction results in emphysema If the lesion is at or near the tracheal bifurcation, one lung or the other is likely to suggest evidence of obstruction of its airway Sessile tumors are equally likely to cause an impairment of the intake and output of air Jackson³⁰ pointed out that with inspiration and expiration there is an increase and decrease in the lumen of the trachea and in those of the bronchial tubes Hence, if partial obstruction of the trachea occurs, emphysema is likely to result This point has also been stressed by Dumas and Guichard⁵ These factors help to explain the paroxysmal nature of the type of dyspnea which accompanies carcinoma of the trachea Respiratory crises can be precipitated by infection and accumulation of secretion as well as by spasm of the bronchi and of the trachea

Cough is present in nearly all instances At the onset it is usually nonproductive, but eventually it is accompanied by expectoration of mucopurulent sputum The obstructive factor is most often responsible for the retention of pulmonary secretions Tracheobronchitis is almost always present and is sometimes accompanied by bronchiectasis of varying severity The sputum is often bloody, at times there is profuse hemoptysis

Thus, the obstructive factor of carcinoma of the trachea may be responsible for shortness of breath (either constant or paroxysmal or both, but in any instance progressive), a crowing or wheezing type of respiration, atelectasis or emphysema, cough, expectoration, pneumonia and hemoptysis Thomson³² declared that the patient most often dies from asphyxia, pneumonia or hemorrhage

Most tracheal carcinomas encroach on the tracheal lumen Many of them, however, invade peritracheal tissues Lesions of the posterior wall or "party wall" of the trachea may extend well into the esophagus In

31 Vinson, P P Primary Malignant Disease of the Tracheobronchial Tree Report of One Hundred and Forty Cases, J A M A **107** 258-261 (July 25) 1936

32 Thomson, St C, cited by Robin and Mann²¹

a certain number of instances the patient complains of dysphagia. In some instances esophagoscopic examination has been carried out³³

Metastasis of tracheal carcinoma to the adjacent lymph nodes is rather common. As has been stated, the lymphatic drainage system of the trachea is closely related anatomically to the recurrent laryngeal nerves. It is not surprising, therefore, that involvement of the mediastinal lymph nodes results in paralysis of the left vocal cord, whereas involvement of lymph nodes situated higher than those of the mediastinum may cause palsy of either or both cords. Thus, hoarseness is at times a symptom of tracheal cancer.

Other symptoms are less common and are evidences of more distant metastasis. Pain is infrequent. When the cervical nodes are involved, extension either to the axilla to involve the brachial plexus or to the paravertebral region to involve the sympathetic chain may occur. Paresthesias of the upper extremities and also Horner's syndrome have been noted. Mediastinal enlargement may result in obstruction of the venous return, causing distention of the veins of the head and neck.

DIAGNOSIS

The existence of carcinoma of the trachea may be suspected from the clinical history and the results of the physical examination, this does not often happen, however, because of the rarity of the condition. Tumors of the larynx or of the lung are considered likely possibilities when the patient presents himself for examination. In most instances a diagnosis of asthma is made at some stage of the disease. This is particularly true when the tumor has produced obstructive emphysema. It is well to recall Jackson's³⁰ pertinent aphorism, "All is not asthma that wheezes." The paroxysmal nature of the dyspnea likewise misleads the physician. Other conditions frequently suspected are carcinoma of the thyroid, mediastinal tumor, tuberculosis, cardiac disease and chronic bronchitis. Some such disease as bronchiectasis, pneumonia, atelectasis or emphysema (any of which may result from the tracheal obstruction) is often considered the primary condition.

Roentgen examination of the thorax may disclose evidence of mediastinal enlargement or peripheral pulmonary disease but does not often help in the recognition of tracheal tumor. Roentgen study of the trachea in the lateral view may disclose invasion of the tracheal lumen. The

33 (a) Gilfoy, F. E. Primary Malignant Tumors of the Lower Third of the Trachea. Report of a Case with Successful Treatment by Electrofulguration and Deep X-Rays, *Arch. Otolaryng.* **16** 182-187 (Aug.) 1932. (b) Guisez, J. Du cancer primitif de la trachée et des grosses bronches, *Bull. d'oto-rhinolaryng.* **18** 9-21, 1919-1920. (c) Harris, T. J., and Forbes, H. H. Carcinoma of the Trachea, *Laryngoscope* **35** 53 (Jan.) 1925. (d) Chevallier¹⁷. (e) Stenn²⁵.

technic of such examinations has been discussed by Saupe,³⁴ Lachapele,³⁵ Ellinger³⁶ and Weiss and Biermann.³⁷ Lateral roentgenograms aided in the diagnosis of 2 tracheal carcinomas in our series.

Tracheal tumors at times can be visualized by means of the laryngeal mirror. In 4 cases at the Mayo Clinic the diagnosis was postulated by this means. In nearly all instances, however, the use of the bronchoscope is essential to the diagnosis. For 13 of our 16 patients the diagnosis was definitely established by tracheoscopic examination, and in 9 instances there was no hint as to the real condition until the tracheoscopic examination had been performed.

The appearance of the lesion as seen through the bronchoscope is variable. Frequently an ulcerating tumor mass is seen. Sometimes a grayish white or reddened nodule is the only finding. The tracheal mucosa is usually ulcerated at some point. Regardless of the gross appearance of the tumor visualized, however, microscopic examination of a specimen taken for biopsy removed through the bronchoscope is essential for an accurate diagnosis.

PROGNOSIS

The prognosis of carcinoma of the trachea is unfavorable. Review of the cases reported in the literature reveals that most of the patients thus afflicted die within six to eighteen months after they are seen by the physician. The diagnosis in the majority of these cases was not made during the life of the patient, hence no treatment was given. Generally, when the correct diagnosis was made the condition was far advanced. The relatively early obstruction to respiration and the occurrence of secondary pulmonary disease, such as pneumonia, abscess of the lung, atelectasis or emphysema, hasten death. As has been stated, death most frequently results from suffocation, pneumonia or hemorrhage. As a rule the patient's general physical condition remains fairly good until the terminal phase of the disease.

Treatment of carcinoma of the trachea is difficult and, on the whole, unsatisfactory. Reports in the literature indicate that in most instances treatment was unavailing or afforded only temporary benefit.

34 Saupe, E. Beitrag zur rontgenologischen Darstellung von in die Trachea einbrechenden Tumoren, *Rontgenpraxis* 8 156-159 (March) 1936.

35 Lachapele, A. P. Sur un case de tumeur de la trachee, *Bull. et mem. Soc. de radiol. med. de France* 24 467-468 (May) 1936.

36 Ellinger, E. Zur Rontgendiagnose der Trachealtumoren, *Fortschr. a. d. Geb. d. Rontgenstrahlen* 54 226-230 (Sept.) 1936.

37 Weiss, T., and Biermann, E. Ein intratrachealer Tumor, der rontgenologisch diagnostiziert und auf endobronchialen Weg entfernt werden konnte, *Rontgenpraxis* 4 309-312 (April) 1932.

For illustrative purposes, a study was made of observations on 38 cases collected from the literature, specific treatment for a definite tracheal carcinoma was attempted. Eighteen of the 38 patients were dead when the reports were published. Only 2 of these survived more than one year. The cases of 13 of the 20 living patients were reported within eight months from the time of treatment.

Of these 38 patients, 6 had squamous cell carcinomas, 12 had adenocarcinomas and 6 had basal cell carcinomas. Five of the 6 patients with squamous cell tumors were reported as dead, and the remaining patient was reported alive, six months after treatment. Of the 12 patients with adenocarcinomas, 6 were dead and 6 were alive at the time the reports were published. Of the patients with basal cell tumors, 5 were alive

TABLE 2—*Type of Treatment and Number of Patients Surviving in a Series of Thirty-Eight Cases of Carcinoma of the Trachea in the Literature*

Type of Treatment	Patients Living	Patients Dead
Simple removal	9	9
Simple removal and radium therapy	2	4
Simple removal and roentgen therapy	1	0
Radium therapy alone	1	3
Roentgen therapy alone	1	2
Resection of the trachea	6	0
Total	20	18

and 1 was dead. These figures would indicate that squamous cell carcinomas are more malignant and less amenable to treatment than are glandular and basal cell carcinomas.

Another point of interest is the situation of the lesion as correlated with the results of treatment. Of the patients reported as living, 14 had lesions in the upper third of the trachea and 5 had lesions in the lower third. On the other hand, of the patients who died after treatment, 7 had lesions in the upper third of the trachea, 9 had lesions in the lower third and 2 had tumors situated in the middle third. As might be expected, the prognosis in general appears to be somewhat more favorable when the tumor is situated in the upper portion of the trachea.

Detailed information as to the type of treatment used for these 38 patients was frequently lacking. The term "simple removal" was used to designate the treatment of patients from whom the tumor or part of the tumor was removed with the surgical knife through a tracheotomy wound or to designate instances in which portions of the tumor were obtained with the endoscopic forceps through the bronchoscope. In a few instances^{23a} the tumors were fulgurated with diathermy. Table 2

is a résumé of the treatment used for 38 patients whose records were collected from the literature, together with the results obtained

Table 3 is presented to evaluate the treatment employed for 16 patients with carcinoma of the trachea encountered at the Mayo Clinic (1 of these was not treated at the clinic)

It is to be noted that of the 15 patients treated at the Mayo Clinic 7 died within eleven months after they were first seen there. One additional patient died of unknown causes at least five years after his tracheal carcinoma had been treated. Of this group, 7 patients are now living after treatment

The following facts must be noted concerning the patients who died. Two patients (cases 6 and 13) were in such a hopeless condition when encountered at the clinic that no treatment could be administered. Both died within two months after consultation. One patient (case 14) had metastasis to the left frontal region when he was first encountered. He was given palliative roentgen treatment, he died in two months. Two patients (cases 5 and 15) were given treatment with roentgen rays and obtained temporary benefit, but both died subsequently. Tracheotomy was performed on 1 patient (case 4), and the tumor was fulgurated with surgical diathermy. He improved temporarily, but metastases developed and he died eight months later. One patient (case 11) was treated by implantation of radium directly into the tumor and subsequently was given treatment with roentgen rays. About two weeks later this patient had a profuse pulmonary hemorrhage and died. Of the 7 patients who died, 3 had squamous cell carcinomas (2 were graded 4 and 1 was graded 2 according to Broders' index). The other 4 patients had adenocarcinomas (2 were graded 4, 1 was graded 3 and 1 was graded 2).

In reviewing the histories and observations concerning the 7 living patients, the following facts are of interest. The interval since treatment of these patients varies from nine months to nine and a half years. The patient (case 10) who underwent resection of the larynx and trachea has been well for eighteen months at the time of writing. She is expecting to return to the Mayo Clinic for reexamination. The patient in case 12 has been entirely well since treatment with surgical diathermy and roentgen rays without additional therapy. The patient in case 7 has been entirely well for five and a half years. This patient returns at periodic intervals for bronchoscopic examination, and on several occasions cauterization of recurrent tumor tissue has been performed. At the most recent examination no tumor was found. The patient in case 2 has been well since his tracheal tumor was last fulgurated, eighteen months prior to the writing of this paper. The patient in case 1 has been well since surgical diathermy was performed, nine months before the time of writing. The patient in case 8 is well eight years after her

TABLE 3—*Resume of Sixteen Cases of Carcinoma of the Trachea Encountered at the Mayo Clinic from 1921 to 1939*

Case	Sex of Patient	Age of Patient	Diagnostic Method	Treatment	Result	Survival After Treatment*	Lesion	Location of Lesion
1	F	59	Bronchoscopic	Surgical diathermy	Well	9 months	Squamous cell carcinoma grade 1	Lower third
2	M	35	Roentgenologic, bronchoscopic	Forceps removal, diathermy	Alive, good health	18 months	Adenocarcinoma grade 1	Middle third, right anterolateral walls
3	F	32	Roentgenologic, bronchoscopic	Roentgen therapy	Alive, well	2 years	Adenocarcinoma grade 1	Upper third, posterior and right lateral walls
4	M	71	Bronchoscopic	Surgical diathermy, tracheotomy, roentgen therapy	Metastasis, death	8 months	Squamous cell carcinoma grade 4	Upper third, posterior and lateral walls
5	F	36	Bronchoscopic	Roentgen therapy	Death	11 months	Adenocarcinoma grade 4	Middle, lower thirds, posterior and right lateral walls
6	M	57	Laryngoscopic		Death, pneumonia	2 months	Adenocarcinoma grade 3	Middle third (annular)
7	M	65	Bronchoscopic	Diathermy, some roentgen therapy	Alive, well	5½ years	Adenocarcinoma grade 1	Lower third, right lateral wall
8	F	40	Bronchoscopic	Roentgen therapy (one treatment)	Alive, good health	8 years	Squamous cell carcinoma grade 3	Multiple
9	M	70	Roentgenologic, laryngoscopic	Tracheotomy, radium	Improved	Died, 5 to 10 years	Adenocarcinoma grade 1	Upper third, anterior wall
10	F	41	Bronchoscopic, tracheotomy performed	Resection of trachea and larynx	Alive	1½ years	Adenocarcinoma grade 1	Upper third, right lateral and posterior walls
11	F	43	Bronchoscopic	Roentgen therapy	Improved, died	6 months	Adenocarcinoma grade 2	Lower third, anterior and left lateral walls
12	F	29	Laryngoscopic	Tracheotomy, surgical diathermy, roentgen therapy	Alive, well	9½ years	Squamous cell carcinoma grade 3	Middle third, posterior and right lateral walls
13	F	46	Bronchoscopic		Died	2 months	Adenocarcinoma grade 4	Lower third, right lateral wall
14	M	46	Bronchoscopic	Roentgen therapy, tracheotomy	Died	2 months	Squamous cell carcinoma grade 4	Lower third, right lateral wall
15	F	42	Laryngoscopic, bronchoscopic	Tracheotomy, radium roentgen therapy	Pulmonary hemorrhage, died	2 weeks	Squamous cell carcinoma grade 2	Lower third, right lateral wall
16	M	77		None	Died	9 months	Not known	Upper third (annular)

* At the time of writing of this paper

visit to the Mayo Clinic. The disappearance of this patient's tumor after one treatment with roentgen rays is difficult to explain.

In 8 patients who responded well to treatment the types of tumors observed were as follows: 1 multiple squamous cell carcinoma (grade 1), 2 squamous cell carcinomas (both grade 3) and 5 adenocarcinomas (all grade 1).

COMMENT

The conclusions which may be drawn from the study are clear. Squamous cell tumors are much less amenable to treatment than are adenocarcinomas. The efficacy of treatment is inversely proportional to the grade of malignancy of the tumor, grade 1 being most amenable to treatment and grade 4 least amenable (5 of the 8 patients treated successfully had grade 1 adenocarcinomas). The most important single factor in the establishment of a prognosis is the relative malignancy of the tumor in question. The relative proportion of differentiated cells is a good criterion of the degree of malignancy.

Obviously, no sweeping conclusions can be drawn as to the treatment of choice for carcinoma of the trachea. Many patients present themselves during advanced stages of the disease, and medical measures, emergency tracheotomy or palliative roentgen treatment are the only possible methods of therapy. The situation and extent of the lesion and the presence or absence of metastases are factors which govern the success or failure of any type of therapeutic endeavor. Widespread lesions are much less amenable to treatment than are localized tumors. Carcinomas of the upper portion of the trachea are ordinarily more accessible than are tumors in the lower part of the trachea. Papillomatous lesions are more easily removed than are lesions which infiltrate the walls of the trachea and invade the surrounding tissues. Such factors will influence the selection of treatment for each patient.

Provided the circumstances are favorable, carcinoma of the trachea is by no means a hopeless condition. The outlook is not always gloomy if an early diagnosis can be made. An accessible tumor of a low grade of malignancy and of a glandular cell type frequently can be eradicated. It is possible to remove portions of the tumor with forceps through the bronchoscope or to excise the tumor through a tracheotomy wound. Subsequent cauterization of the remaining tumorous tissue and of the base of the tumor with surgical diathermy may be performed. Implantation of radon seeds or administration of roentgen therapy may be utilized to supplement the treatment. Periodic bronchoscopic examination may suggest the necessity of further cauterization. For 4 patients of the Mayo Clinic such procedures have resulted in permanent beneficial results over periods of several years. These patients are clinically cured.

Favorable results may be obtained by resection of the trachea as is illustrated by the treatment of 6 patients reported on in the literature and that of 1 patient of the Mayo Clinic. The disfigurement, vocal impairment and constant menace of pulmonary infection are disagreeable accessory results which make such radical surgical treatment undesirable.

The use of roentgen rays as the only treatment for carcinoma of the trachea has been advocated by some authorities. Rathbone¹⁹ reported the apparent cure of a patient with a basal cell carcinoma by this means. Barlatoux³ presented 2 cases in which the patients were markedly improved by roentgen therapy. Ellinger³⁶ expressed approval of this method of treatment. In some instances roentgen rays have been used in addition to diathermy or surgical removal of the carcinoma.

It has been pointed out³⁰ that the use of roentgen rays or radium results in perichondritis and necrosis of the tracheal cartilages. This occurrence may well account for the sudden death of a number of patients who received repeated doses of roentgen rays. The patient reported on by Vinson and Leddy⁹ (included in the present series) was given roentgen treatment only. She made a remarkable improvement but died rather suddenly about three months after the final course of therapy. However, 2 patients in the series under consideration were benefited by roentgen treatment and are living at the time of writing, 1 is living eight and 1 two years after cessation of therapy. Neither of them received massive doses. One of them has had repeated roentgen treatment at intervals of several months. The life of 1 patient was prolonged several years by means of repeated external applications of radium.

SUMMARY AND CONCLUSIONS

Sixteen patients with carcinoma of the trachea encountered at the Mayo Clinic from 1921 to 1937 are reported on, and the literature on primary carcinoma of the trachea is reviewed. An attempt is made to correlate the pathologic, clinical and therapeutic aspects of this condition. The following points are emphasized:

1. The diagnosis of tracheal carcinoma is made most readily by means of bronchoscopic examination. This procedure should be carried out in any instance in which obstruction of the upper air passages is not explained or in which there is no obvious reason for hoarseness of the patient or paralysis of the vocal cords.

2. Specimens for biopsy should be taken from the tumor. It is important to determine whether the carcinoma is of glandular or squamous cell type. The degree of malignancy of the tumor should be estimated.

3 The relative malignancy of a carcinoma may be ascertained by grading the tumor according to the method of Broders. The classification of carcinomas into four grades is made on the basis of the ratio of differentiated to undifferentiated cells.

4 Although the prognosis for carcinoma of the trachea is admittedly poor, there are occasions when accessible tumors of the glandular cell type of a low grade of malignancy are amenable to treatment.

5 Local removal and cauterization with surgical diathermy appear to be the most efficacious methods of treatment. These procedures may be carried out through the bronchoscope or through a tracheotomy wound.

6 Surgical resection of the trachea is the treatment of choice when tumors of the squamous cell type or of a high grade of malignancy are encountered. Treatment with roentgen rays or implantation of radon seeds may be of definite value in some instances.

Case Reports

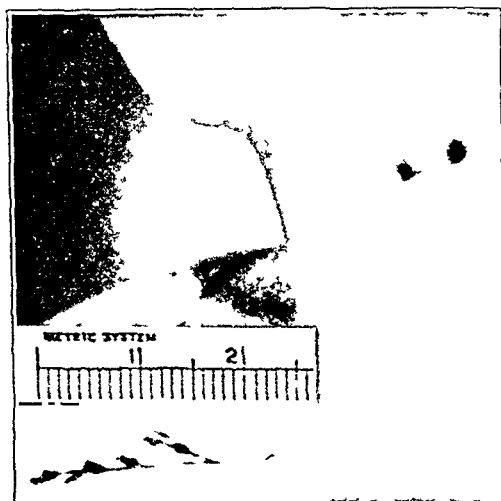
CERVICAL ABSCESS RESULTING FROM UNUSUAL FOREIGN BODY IN THE PHARYNX

LEWIS E. ETTFR, M.D., WARRENDALE, PA

The following case is believed of interest because what at first appeared to be the localization of an abscess in the cervical glands secondary to recurrent infection of the throat turned out to be an abscess from swallowing a stalk of June grass

A D, aged 15, living on a farm, suffered from symptoms of infection of the throat intermittently for three months before what seemed to be cervical adenitis of the left anterior cervical glands developed

On April 15, 1938, he was first seen and was treated for acute tonsillitis, of which he showed typical local and general symptoms, with a temperature of 101



Cervical abscess resulting from a foreign body in the pharynx Inset, the foreign body

F and a pulse rate of 100 He was kept in bed five days, after which time the throat had greatly improved, but he returned to the office two days later with a peritonsillar abscess breaking spontaneously and draining completely

On May 31 he returned for treatment of subacute pharyngitis and was discharged as cured two days later With this infection he did not have fever or adenitis There was no complaint of tickling in the throat or any cough at the time

During the month of June he began to complain of a swollen neck and a sore throat and of general malaise, but he did not come for treatment until July 5 During this time there was no cough or tickling sensation in the throat Examination disclosed a large indurated mass to the left of the thyroid cartilage, extending backward to the sternocleidomastoid muscle and upward to the mandible There was marked stiffness of the neck the patient being unable to rotate the head without turning the whole body and there was considerable dysphagia

The swelling was interpreted as being due to acute cervical adenitis secondary to the previous infections. The patient was put to bed and moist heat applied to his neck, after which the induration gradually subsided and the temperature returned to normal. By July 13 an area of softening developed 5 cm to the left of the midline, which was incised and drained of a small amount of pus. The swelling continued to subside, but medial to the first incision another area of softening developed, which was drained several days later of a small amount of blood and pus.

After this the swelling reduced to a small indurated mass directly under the incisions. The medial one stopped draining and closed in a few days, but the lateral one continued to ooze thin pus and took on the appearance associated with chronic infection of a sinus.

Examination on July 30 showed a small piece of what appeared to be vegetable matter protruding from the opening of the first incision, traction on which resulted in withdrawal of the head of a stalk of June grass, proximal end first.

Further questioning of the boy elicited that he frequently not only chewed the proximal ends of grass stems, as many people do, but ate the top of the stalk as well. It is remarkable that the piece obtained could have lodged in his throat and perforated the pharyngeal wall without at some time having produced tickling or local irritation of the throat. The grass probably was arrested in the hypopharynx where it is narrowest, just before it merges with the esophagus, and eroded through the wall and the cervical fascia to the tissue space anterior to the carotid sheath, where the abscess formed and localized.

The confusing coincident symptoms at onset and the evolution in this case suggest an unusual possibility to be kept in mind in the differential diagnosis and the study of the causes of cervical abscess.

Progress in Otolaryngology

Summaries of the Bibliographic Material Available
in the Field of Otolaryngology.

THE PARANASAL SINUSES

MALIGNANT TUMORS

SAMUEL SALINGER, M D
CHICAGO

(Concluded from page 479)

Ringertz ¹²⁸ monograph is based on a study of the pathologic material of Sabbatsberg's Oto-laryngological Clinic and Radiumhemmet of Stockholm as well as a large material drawn from outlying districts. Between 1921 and 1935, 391 patients with malignant tumors of the sinuses were treated. The clinical observations have been discussed by Oehngren, Holmgren, Berven and Ahlbom in previous publications. Nineteen different types of tumor were found, squamous cell carcinoma being found in the largest single group numbering 218. The article which is well illustrated, is replete with descriptions of various types of tumors, particularly the unusual tumors such as cylindroma, reticulocytoma, plasmocytoma, Ewing's tumor and malignant melanoma. A brief clinical record of each of the 391 cases is extremely helpful in evaluating the histopathologic observations as described by the author. The monograph is an excellent piece of work, worthy of study and should prove very useful for reference.

New ¹²⁹ reviews his own statistics on carcinoma of the antrum and upper jaw as published in 1935 showing 53.8 per cent five year cures, also Oehngren's statistics of 1937 showing 35 per cent five to twelve year cures. He comments on the improvement in results over previously published statistics which he attributes to earlier diagnosis, more thorough surgical exposure, use of surgical diathermy and postoperative use of radiation. He also makes a point of thorough eradication at the first attempt, disregarding the possible facial deformity, particularly in view of the excellent results of subsequent plastic reconstruction.

Szende ¹³⁰ reports on the material studied in Verebely's clinic at Budapest over a seventeen year period. There were 70 cases of malig-

¹²⁸ Ringertz N. Pathology of Malignant Tumors Arising in the Nasal and Paranasal Cavities and Maxilla. Acta oto-laryng., 1938, supp. 27, p. 1.

¹²⁹ New C. B. Malignant Diseases of the Paranasal Sinuses, Am J Surg 42:170 (Oct.) 1938.

¹³⁰ Szende B. Die bösartigen Geschwülste der Nasennebenhöhlen, Monatsschr. f. Ohrenh. 72:925 (Oct.) 1938.

nant disease of the sinuses, in 63 of which the diagnoses were carcinoma and sarcoma. The earliest symptom usually was pain referred to the teeth or the face. In many cases the malignant condition was discovered after extraction of a tooth. Slight trismus due to spasm of the internal pterygoid muscle proved to be an unfavorable symptom. In 4 cases there was a history of previous operation for polyp, and in 4 cases the earliest symptom was nasal hemorrhage. In most of the cases, however, there was little or no indication of the growth until it had assumed a rather large size. In 26 cases there was associated suppuration in the sinuses. In 14 of 34 instances carcinoma of the antrum affected the orbit, causing exophthalmos. The treatment followed was radical excision with subsequent irradiation of the involved region. In 7 cases the lesion could not be completely extirpated because of extensive involvement. In 9 cases the external carotid artery was tied. Partial resection of the maxilla was done in 16 cases, a complete resection with sphenoethmoid exenteration, in 27. Roentgen treatment was begun about eight to ten days later with fractional doses up to 6,000 roentgens (1). In cases of incomplete removal or of recurrence the author recommends that radium be placed in the cavity.

Spencer¹³¹ reviews 11 cases of malignant tumor of the sinuses seen at the Colorado General Hospital from 1924 to 1936, discussing the diagnosis and treatment. He advises early removal by diathermy combined with surgical treatment, followed by applications of radium or roentgen rays, depending on the type of growth, extent and radiosensitivity. A follow-up of the patients revealed only 2 now living, 5 patients could not be reached. The author comments on the fact that clinic patients are usually seen when the tumor has reached a late stage and the prognosis is bad.

Myerson¹³² found carcinoma of the sinuses in less than 1 per cent of all patients admitted to the Brooklyn Cancer Institute. There were only 5 with such cancers among the 737 admitted. He favors the approach described by New, Barnes and Greene and the combination of surgical operation, diathermy and irradiation. Advanced tumors, with swelling of the cheek, should be exposed through an external incision.

Powell¹³³ reports 7 of 18 patients alive and well three months to twelve years after operation. His treatment is to open the antrum

131 Spencer, F. R., and Black, W. C. Malignant Disease of the Nasal Accessory Sinuses, with a Review of Eleven Cases, *Laryngoscope* 48:77 (Feb) 1938.

132 Myerson, M. C. The Management of Cancer of the Nasal Sinuses, *Laryngoscope* 48:615 (Sept) 1938.

133 Powell, L. A Report of Eighteen Consecutive Cases of Malignant Disease of the Maxillary Antrum Treated by Radium Inserted into the Cavity After Removal of the Main Mass, *Roy. Berkshire Hosp. Rep.* (1936-1937), 1938, p. 124.

through the anterior wall and "clear out" the main mass, sometimes using diathermy, but with no attempt at radical removal. Forty milligrams of radium screened by 5 mm of lead is placed in the cavity and held in place fifty to one hundred hours. A second application was given in a few cases. Roentgen rays of high voltage were used in 2 cases some years after the initial treatment, with good results, although sloughing followed.

From the Manchester Radium Institute Nuttall¹³⁴ reports 167 cases of carcinoma of the palate. In 94 per cent the lesion involved the middle third, spreading to the alveolus, and in nearly all cases it invaded the antrum as well. He calls this a typical site for the origin of an antral lesion, which should be so treated regardless of the roentgenographic findings. In many of these cases the antral carcinoma was missed and the patient, having been inadequately treated, came back with a recurrence. Of 104 patients whose antrums were investigated in this group, 70 were referred with wrong diagnoses. In 55 of these the antral carcinoma was missed elsewhere but was recognized in the Manchester Radium Institute, and in 15 it was not recognized at all until recurrence had taken place. The author stresses the importance of this relationship of antral to palatal carcinoma and states that since they have recognized this fact their record in diagnosis and treatment has improved.

Jacques, Grimaud and Thomas¹³⁵ were forced to operate twice for an extensive carcinoma of the antrum which involved the medial and inferior orbital walls in a man of 68. The external approach was used in both instances, and surgical removal was followed by local application of radium. The wound healed smoothly, leaving a deep cavity lined with mucosa and extending from the unsupported bulb above down to the maxillary floor below and from the nasal septum medially to a fibrous band which was all that was left of the external wall of the sinus. Since the bulb remained in position and the vision was good, the authors contemplated no plastic reconstruction, on account of the patient's age.

Torrighiani¹³⁶ advises a permanent opening in the hard palate protected by a plate for the purpose of better surface irradiation after removal of the growth and for subsequent inspection of the cavity. If

134 Nuttall, J. R. Carcinoma of the Palate. How Often Does It Mark Malignant Disease in the Maxillary Antrum? *Brit. M. J.* **1** 839 (April 16) 1938.

135 Jacques, P., Grimaud, R., and Thomas, C. Epithélioma de l'antre maxillaire avec destruction du plancher de l'orbite. Guérison avec bonne conservation des fonctions oculaires, Résultats de trois ans d'observation, *Bull. Soc. d'opht. de Paris* **50** 302 (May) 1938.

136 Torrighiani, C. A. Sobre las ventajas de una apertura permanente en el paladar óseo o en la órbita, en las operaciones por tumores malignos de las fosas nasales y senos anexos, *Dia med.* **10** 830 (Aug. 15) 1938.

the growth is higher up, involving the ethmoid or orbit, he favors removal of the bulb and the ethmo-orbital wall for the same reasons.

A case of Ewing's tumor of the maxilla in a man of 38 is described by Pierangeli¹³⁷. There was a history of severe trauma to the nose a year earlier, resulting in a septal hematoma and abscess. The tumor, which appeared a year later, started in the antrum and invaded the nasal cavity as well as the canine fossa and the floor of the orbit. Biopsy revealed Ewing's tumor. The growth was treated by combined intramural and external irradiation, 15 millicurie doses in the former and 24 in the latter. Temporary regression was followed by general adenopathy and local recurrence, resulting fatally.

Connor¹³⁸ reports a metastatic hypernephroma of the frontal, ethmoid and maxillary sinuses in a woman of 52. The metastasis in the sinuses was on the side contralateral to the involved kidney. The histologic report described the tumor as a "mass of epithelial cells in alveolar nests showing relatively small dark-staining nuclei and wide clear somewhat foamy cytoplasm which appears to grow out of the inner plate." Despite extensive surgical removal and massive irradiation of the region, the patient succumbed.

Satomura¹³⁹ found a large basal cell carcinoma of the frontal sinus in a man of 59. There was a history of nasal block and discharge since childhood. Three months previously a swelling appeared over the right frontal region, which at first was painless. It gradually increased in size to approximately that of a man's fist. Pains, headaches, bloody nasal discharge and impairment of vision followed. The tumor could not be completely removed, as it had already invaded the dura.

Asano¹⁴⁰ reports epithelioma of an extraoral salivary gland which was discovered in the ethmoid region. The findings were nasal block, hemorrhage, a dense elastic tumor in the right nasal cavity and roentgen indications of an ethmoid origin. The mass was removed by external operation.

Bachi's¹⁴¹ case was that of a squamous cell carcinoma involving the sphenoid and ethmoid sinuses and the base of the brain in a woman of 48. There was a history of some trauma to the nose about a year before. The onset was indicated by failing vision, headache and exophthalmos.

137 Pierangeli, C. E. Il sarcoma di Ewing del mascellare, *Oto-rino-laring ital* **8** 133 (April) 1938.

138 Connor, C. E. Metastatic Hypernephroma of the Right Frontal, Ethmoid and Maxillary Sinuses, *Arch Otolaryng* **28** 994 (Dec.) 1938.

139 Satomura, T. Ein Fall von enorm grossem Krebs in der Stirnhohle, *Oto-rhino-laryng* **11** 520 (June) 1938.

140 Asano, M. Ueber extraorale Speicheldrusengeschwulst der Siebbeinzellen, *Oto-rhino-laryng* **11** 626 (July) 1938.

141 Bachi, S. Carcinoma primitivo del seno sfenoidale, *Valsalva* **14** 390 (Aug.) 1938.

Roentgenograms revealed a shadow in the area of the sphenoid sinus with obliteration of the roof. Operation was performed under intratracheal anesthesia through a Moure incision. A compact mass was disclosed involving the posterior ethmoid region with destruction of the anterior and lateral sphenoid walls. Postoperative irradiation of the region was followed by recurrence, metastases and death. The author claims that the literature records only 40 cases of malignant tumor of the sphenoid sinus, in only 10 of which the tumor was carcinoma, the reason for this small number being that such a tumor is seldom diagnosed early enough to enable the observer to say definitely just where the point of origin is.

BENIGN TUMORS

Osteoma—Most of the articles on osteoma the past year have been in the nature of case reports with varying features of special interest. Nothing new is offered. The most extensive work on the subject, which includes a bibliography of about 350 references, is offered by Malan,¹⁴² who covers every phase of the topic thoroughly. He reports 5 cases of osteoma of his own affecting the frontal and ethmoid sinuses and 3 cases of exostosis or hyperostosis. He has collected the records of 458 cases from the literature and finds that in 38.95 per cent the osteoma was located in the frontal sinus, in 23.85 per cent in the ethmoid sinus and in 8.97 per cent in the antrum and the rest in adjacent bone. He divides them into four groups: eburnated, compact, spongy and mixed. As to genesis, he believes that the tumor has its origin in embryonal vestiges that are dormant for a long time but develop slowly after the cranial bones are already ossified. Trauma and infection play some part in stimulating their growth.

Hempstead's¹⁴³ osteoma was in a boy of 17. It was very dense and had to be removed *en masse*. The os planum and parts of the lacrimal, nasal and superior maxillary bones were removed to gain access to it. The tumor measured 4.5 by 4 by 2.5 cm.

Ersner and Saltzman¹⁴⁴ reported a case because the tumor involved all of the sinuses on one side, only 2 similar cases having previously been recorded in the literature, according to the authors. Operation disclosed the mass involving the frontal, ethmoid and sphenoid sinuses and the nasal cavity and eroding the nasointermaxillary wall into the antrum, which was almost obliterated. It was removed by mallet, gouge and electric drill. It weighed 70 Gm and measured 6 by 4 by 1.5 cm. The

¹⁴² Malan, E. *Chirurgia degli osteomi delle cavità pneumatiche perifacciali* (Contributo anatomo-clinico), *Arch. ital. di chir.* **48** 1, 1938.

¹⁴³ Hempstead, B. E. *Osteomas of Paranasal Sinuses and the Mastoid Process. Report of Cases*, *J. A. M. A.* **111** 1273 (Oct. 1) 1938.

¹⁴⁴ Ersner, M. S., and Saltzman, M. *Osteoma of the Sinuses*, *Laryngoscope* **48** 29 (Jan.) 1938.

authors recovered almost a pure culture of *Staphylococcus albus*, which to them was significant because of the frequent association of this germ with osteomyelitis. Since the latter process is often associated with new bone formation, they consider the possibility of the organism being the cause of the development of the tumor.

The case described by Campbell and Gottschalk¹⁴⁵ is interesting because of the association of the osteoma with a mucocele which was in contact with the anterior horn of the lateral ventricle, into which it had ruptured. Aside from headaches and convulsions, the man complained of sounds of "splashing" or of "water flowing" in his head, which could be heard through a stethoscope placed at either temporal region. Roentgenograms revealed the tumor extending backward from the frontal sinus and air in the lateral ventricle which moved to the region of the tumor when the patient changed the position of his head. The mass was removed through a frontal osteoplastic craniotomy. The defect in the dura was patched with temporal fascia. Recovery ensued.

Ito¹⁴⁶ removed an isolated osteoma durum intranasally from a girl of 17 in whom the chief complaint was recurring nasal hemorrhage. It was attached by a short pedicle to the anterior portion of the intranasal wall of the ethmoid and measured 2 by 0.81 by 0.6 cm. and weighed 3.8 Gm.

The tumor which Wildenberg¹⁴⁷ reports was unusually large, weighing 100 Gm., and occurred in a man of 48. It was removed in one piece without loss of spinal fluid despite its attachment to the dura over an area of a franc piece. It measured 10 by 5 cm. at its widest diameter. The author speaks of the danger of fracturing the cribriform plate and tearing the dura and advises the use of a gigli saw for isolating such a mass.

Sattler¹⁴⁸ quotes Belluci, who claimed that post-traumatic osteoma can be prevented by exposure to roentgen rays. No evidence has been produced anywhere in the literature to substantiate this statement. He expressed the belief that constitutional hereditary factors play the most important role in the causation of this growth. Numerous drawings from roentgenograms are produced to show the frequency of small osteomas which are discovered only by accident.

145 Campbell, E. H., and Gottschalk, R. B. Osteoma of Frontal Sinus and Penetration of Lateral Ventricle, with Intermittent Pneumocephalus, *J. A. M. A.* **111** 239 (July 16) 1938.

146 Ito, M. Ein geheilter Fall von Osteom der Nase unter der Hauptklage von Nasenblutung, *Oto-rhino-laryng.* **11** 408 (May) 1938.

147 Van den Wildenberg. Osteome fronto-ethmoïdo-maxillaire. *Ann d'oto-laryng.*, June 1938, p. 519.

148 Sattler, A. Osteome der Stirnhöhlen, *Ztschr. f. Hals-, Nasen- u. Ohrenh.* **43** 464, 1938.

Rawlins¹⁴⁹ claims that osteoma of the maxillary sinus is rare, having found reports of only 29 cases in the literature, to which he adds a report of 2 of his own. One of the patients was a man of 67, the tumor being discovered accidentally in a routine roentgenogram of the sinus. There was a history of a nail having been run through the hard palate thirty-five years previously. Pus was found in both antrums. The growth was found filling the antrum and attached by a pedicle to the anterior, inferior and mesial corner of the sinus, at the point where the nail had perforated. The second patient was a girl of 19 who had had a painless swelling of the left side of her face for twelve years. Recently its growth became accelerated. The tumor extended from the palate to the floor of the orbit, causing exophthalmos, and when removed was found to consist of a dense capsule and a spongy central mass. While the tumor in the first case was well differentiated bone, that in the second was less mature, showing osteoclasts with moderate osteoblastic activity and cellular fibrous tissue in the marrow spaces.

Benjamins¹⁵⁰ describes an osteoid fibroma of the frontal sinus with atypical calcification in a girl of 19. He states that such a tumor grows superficially, giving rise to pseudocysts covered with tumor tissue and displacing adjacent tissues. The roentgen shadow produced resembles that of osteitis fibrosa. A typical finding is the presence at operation of a brittle tissue which on bisection shows hard granules projecting toward the surface. On microscopic section numerous hyaline bodies with some cell inclusions are found, and centrally there may be some irregular accumulations of lime embedded in a stroma of spindle-shaped cells. The hyaline bodies have the structure of osteoid substance and react similarly to stains.

In Giuffrida's case¹⁵¹ an osteoma of the right ethmoid sinus extending into the frontal sinus was in association with a mucocele in the dilated frontal sinus. He feels that while mucocele in many cases may be idiopathic or primitive, in this instance it was symptomatic or secondary to obstruction of the nasofrontal duct.

Pneumatocoele resulting from trauma in the presence of an osteoma has been frequently reported before. Devic, Ricard and Mansuy¹⁵² observed this condition in a man of 40 who was an addict to alcoholic liquors. His earliest symptom was a sudden loss of consciousness in

149 Rawlins, A. G. Osteoma of the Maxillary Sinus, *Ann. Otol., Rhin. & Laryng.* **47** 735 (Sept.) 1938.

150 Benjamins, C. E. Das Osteoid-Fibrom mit atypischer Verkalkung im Sinus frontalis, *Acta oto-laryng.* **26** 26, 1938.

151 Giuffrida, E. Grosso osteoma fronto-etmoidale con mucocele del seno frontale, *Oto-rino-laring. ital.* **8** 122 (April) 1938.

152 Devic, Ricard and Mansuy, L. Pneumatocoele intracranienne par osteome du sinus frontal, *Lyon méd.* **161** 716 (June 19) 1938.

1927 without apparent cause. In 1929 he had a fall in which the supra-orbital soft tissues were split. In March 1934 he had an attack of hemiplegia, which gradually improved. In August 1934 there was again a sudden loss of consciousness, followed by headache, asthenia and reappearance of the weakness of the leg, extending to the rest of that side of the body. A roentgenogram revealed a dark cauliflower-shaped mass in the midline near the floor of the frontal sinus and a narrow clear space adjoining it. This transparent zone was shaped like a melon and extended from the posterior wall of the frontal sinus backward to the midparietal region. At operation a large mucocele was found in the left frontal sinus. The right frontal sinus was obliterated by a dense osteoma arising from the floor. The dura was exposed, and a fissure was visible in it. This was closed by a suture, and subsequently the air was absorbed. Most of the symptoms cleared up, although the patient suffered two attacks of jacksonian epilepsy within six months after the operation. It is interesting to note that the orbit was uninvolved despite the large size of the tumor.

Cyst—Piquet and Detroy¹⁵³ report a paradental cyst in a woman of 40, which developed in the region of the first and second upper molars, became infected and ruptured through the lower eyelid as well as into the antrum, on which it subsequently encroached. It was removed through a sublabial incision. The lining of the cyst was infected, while that of the antrum was only slightly edematous.

Nakajima¹⁵⁴ and Sato¹⁵⁵ report each an instance of postoperative cyst of the cheek occurring twenty-eight and twenty-one years, respectively, after radical operation on the antrum. In the first case the patient had had no symptoms until the past year, when a swelling appeared in the cheek with slight dull pain. Aspiration yielded a clear thick yellow fluid. The mass receded and then reappeared in four months. Aspiration this time yielded a brown neutral fluid, free from mucus and cholesterol. Operation revealed the cyst situated in a dense mass of fibrous tissue filling the antrum. Its lining was a pale glistening membrane which communicated with the ethmoid cells. In Sato's case there was a history of free bleeding at the time of the original operation, but no other symptoms appeared until twenty-one years later, when the patient began having pain and swelling of the cheek. Further inquiry revealed the fact that there had been previous attacks of pain in the teeth accompanied by swelling. At operation the cyst was found to be

153 Piquet, J., and Detroy, L. Kyste paradentaire du maxillaire superieur fistulise dans la paupiere inferieure, *Echo med du Nord* **90** 337 (June 30) 1938.

154 Nakajima, K. Ein Fall von postoperativer Wangenzyste (Kubo), *Oto-rhino-laryng* **11** 622 (July) 1938.

155 Sato, I. Postoperative Wangenzyste (Kubo) mit 2 Kammern, *Oto-rhino-laryng* **11** 333 (April) 1938.

in communication with the antrum, which it almost filled. It contained a cloudy yellow-brown fluid, in which there were albumin and mucus but no cholesterol. Only a small portion of the lining membrane was covered by cylindric epithelium.

Gutierrez's¹⁵⁶ patient, a man of 32, had a small mass the size of a hazelnut in the supraorbital region for five years without symptoms and practically no change in size during that time. Roentgenograms showed that the mass was in communication with the frontal sinus. Iodized poppyseed oil 40 per cent introduced intranasally set up a reaction with pain and increased swelling. At operation it was found that the cyst, which was a dermoid, had eroded the anterior wall of the sinus but had no direct communication with the nasofrontal duct.

Mucocele-Pyoccele-Pneumatocele—The Japanese are again in the fore with reports of cases of postoperative mucocele of the antrum, which together with the frequency of their reports of cases of postoperative cyst of the cheek, leads one to suspect that there must be something in the technic or postoperative treatment in their cases which is responsible for a complication that is rarely reported in this country. Hirayama¹⁵⁷ observed this condition following the Caldwell-Luc operation in 2 cases, nineteen and seventeen years after operation. He attributes its development in the first case to closure of the natural ostium and in the second case to excessive granulations from the bone and soft tissues. The contents of the cavities were mucin (60 and 23 per cent) cholesterol (6 and 2 per cent) and albumin (30 and 68 per cent).

Morihana¹⁵⁸ did a Caldwell-Luc operation on a boy of 17 on the basis of nasal obstruction, discharge, headache, bilateral polypoid appearance of middle turbinates, pus in the middle meatuses and roentgen shadows indicating involvement of the frontal and ethmoid sinuses and antrums. The left antrum was filled with a clear thick yellow fluid giving a mucin reaction, alkaline and free from pus. Since the ostium was closed by swollen membrane, he assumes that the condition represented the beginning stage of a mucocele.

Fuji¹⁵⁹ reports on a man of 57 who sustained an injury to the frontal area, which was followed by exophthalmos, diplopia and swelling at

156 Gutierrez, A. Quiste dermoideo supurado de la region frontal en comunicacion con el seno frontal, *Rev. de cir. de Buenos Aires* **17** 120 (March) 1938.

157 Hirayama, M. Ueber zwei Falle von der postoperativen Kieferhohlen-mucocele. *Taiwan Igakkai Zasshi* **37** 1163 (July) 1938.

158 Morihana, H. Ein Fall von Mucocele der Oberkieferhöhle, *Oto-rhino-laryng* **11** 515 (June) 1938.

159 Fuji, K. Ueber eine enorm grosse Stirnhöhlenmucocele mit ausschliesslicher Entleerung durch Punktion im Verlauf von 7 Jahren, *Oto-rhino-laryng* **11** 131 (Feb.) 1938.

the internal upper orbital angle. Puncture revealed a chocolate brown mucoid material. Since the patient refused to be operated on, the mass was aspirated twenty-five times over a period of seven years for a total yield of 413 cc. Eventually a Killian operation was performed and the mass removed. The dura was found exposed over a small area, and the nasofrontal duct was blocked.

Greifenstein¹⁶⁰ reports on 8 patients who had cystic masses about the sinuses. Patient 1 was a boy of 15 with swelling at the internal orbital angle since the age of 3. It was removed by external operation. The paper plate, which was displaced externally, was very thin and was therefore removed to allow the bulb to resume its normal position. Hemolytic streptococci were found. Patient 2 was a woman of 65. The bulb had been displaced for one and a half years. At operation the cystic mass was found to have involved the frontal and ethmoid sinuses, whose bony walls though intact were considerably thinned out. An aerobic type of *Staphylococcus albus* was found. Patient 3 was a woman of 63. There were headache, loss of vision, diplopia and impairment of the mobility of the bulb. The mass involved both frontal sinuses, whose septum was gone, and had eroded the bony walls, exposing both orbits and the dura. Patient 4 was a man of 48 who had undergone a Killian operation thirty-one years ago and subsequently an injection of paraffin to overcome the deformity. For the past ten years there had been a swelling at the internal angle of the orbit, which increased in size, displacing the bulb. Operation disclosed the old bony defect involving the floor of the frontal sinus and the paper plate. The cystic cavity extended back to the sphenoid sinus and was the result of complete closure of the nasofrontal duct. Patient 5 was a woman of 52 who had had an operation on the frontal sinuses nineteen years ago. In the past two years she had complained of swelling and severe headaches. Operation revealed a large pyocele filling the ethmoid and frontal sinuses. The fluid contained gram-positive cocci. The nasofrontal duct in this patient also was completely blocked. The sixth patient (a man of 60) had no history of previous infection or operation. There was swelling, displacement of the bulb and intranasal polyps. At operation a bloody cystic mass was found occupying the expanded frontal sinus and ethmoid cells, eroding through the paper plate into the orbit. Sarcomatous degeneration was found, a diagnosis of lymphosarcoma was made, and 8,000 r was administered by the Coutard method, with recession up to the time of writing (one and a half years). Patient 7 was a girl of 12 with headaches and swelling of the right frontal area above the midline and laterally. The mass was removed by external surgical operation and was found to involve the roof of the orbit, extending upward to the dura.

¹⁶⁰ Greifenstein, A. Ueber Muko-, Pyo- und Pneumatozelen, Hals-, Nasen- u. Ohrenarzt (Teil 1) **29** 243 (May) 1938.

Histologic examination revealed a psammoma. The patient was symptom free for twenty-one months. Patient 8 was a man of 28 who seven years previously sustained a fall, striking his forehead with resulting commotio cerebri. Headaches, nausea and vomiting appeared two years ago, followed more recently by swelling above the supraorbital margin. Operation revealed a thin-walled cavity lined with thin mucosa, leading to a broad nasofrontal duct, which was blocked at the middle turbinate by a mucous membrane partition. The condition was bilateral, and the author terms it "pneumosinus frontalis dilatans," citing Boenninghaus as having reported 6 similar cases.

Gleichsner¹⁶¹ describes in detail the history and course of a large mucocoele of the frontal sinus which was in contact with the dura over a wide area. The patient, a woman of 45, gave a history of an injury to the forehead occurring twenty-one years ago. Six years later headache and slight proptosis appeared and then disappeared slowly, but reappeared ten years later. Two years later she sustained another injury in the same area which rendered her unconscious. This was followed by vomiting and aggravation of the previous symptoms. Simple incision released some dark brown fluid, with temporary improvement. An extensive frontal operation was performed later, revealing a deep cavity filled with fluid and extending behind the left eye. The dura was exposed.

Malbran and Oribe¹⁶² report 14 cases of mucocoele in the vicinity of the orbit, in 4 of which it involved the frontal sinus, in 8 the frontal and ethmoid sinuses, in 1 the anterior parts of the ethmoid labyrinth and in 1 the posterior parts of the ethmoid labyrinth. They find that trauma and closure of the nasofrontal duct are the most common etiologic factors. The symptomatic picture and the course are discussed in relation to the point of origin and the direction of growth.

Miscellaneous Growths—Goto and Shiroiwa¹⁶³ removed a fibroma from the antrum of a man of 27. The tumor distended the cheek and nasoantial wall and presented in the mouth at the first upper left molar tooth. Symptoms had been present for only a few months. The mass was removed through a Denker operation and was found to fill the antrum and encroach on the ethmoid cells. It measured 7 by 6 cm.

Takahashi¹⁶⁴ reports 3 cases of a fibroma type of lesion with hemorrhagic areas. In all there was a history of repeated nasal bleeding. In

161 Gleichsner, E. Ueber Mukozelen der Stirnhöhle, Hals-, Nasen- u. Ohrenarzt (Teil 1) **29** 213 (May) 1938.

162 Malbran, J., and Oribe, M. Sobre mucocoeles orbitarios, Arch. de oftal. de Buenos Aires **12** 575 (Sept.) 1937.

163 Goto, S., and Shiroiwa, T. Ein Fall von Fibrom der Kieferhöhle, Oto-rhino-laryng **11** 212 (March) 1938.

164 Takahashi, T. Ueber die Blutgeschwulst in der Kieferhöhle, Oto-rhino-laryng **11** 25 (Jan.) 1938.

2 of the cases the point of attachment was on the nasoantral wall near the ostium. In 1 case the tumor presented in the middle fossa.

Lust¹⁶⁵ discusses the dangers of operating on a tumor of the frontal sinus in the presence of suppurating sinusitis. His patient, a man of 54, succumbed to shock and sepsis. The tumor was known to be present for several years, growing from the roof of the orbit near the internal angle and causing a displacement of the bulb. It was the size of a pigeon's egg, had a fibrous capsule and eroded the roof of the orbit, exposing the dura. There was no connection with the frontal sinus. The tumor contained a colloid brownish secretion and was diagnosed as a myxofibroma.

McAuliffe¹⁶⁶ removed a myxochondroma from a child of 8, which seemed to arise from the anterior portion of the maxillary sinus below the attachment of the inferior turbinate. The tumor presented a swelling over the lateral aspect of the nasal bridge and was excised through a modified Denker operation. The histologic report stated that it was a "teratoid tumor developing in a fetal nest," that "elements of osteogenic sarcoma" were present and that the cells did not resemble sarcoma cells "on account of differentiation, lack of mitotic figures and absence of giant cells." The patient was being kept under observation, nevertheless, because of possible subsequent malignant degeneration.

Tsuruyama¹⁶⁷ removed an antral polyp measuring 9 by 3 cm from a girl of 14 by a Denker operation. The mass originated in the antrum, grew through the fontanel and filled the nasal cavity from the anterior naris to the posterior choana. Histologically it consisted of an anterior and a posterior portion—the former was a grayish red, soft, bleeding irregular mass, which resembled a cavernous angioma, and the latter was a typical edematous polyp.

Silbernagel¹⁶⁸ reports the removal of a lipoma from the right antrum of a man of 50 and claims to have found only one other similar case recorded in the literature. His patient complained of typical vasomotor symptoms, and on roentgen examination with iodized oil a mass was observed outlined in the antrum, on removal it measured 1.5 by 1.5 by 2.5 cm. It had the gross appearance of fat covered by polypoid mucosa. The histologic diagnosis was lipoma.

165 Lust. Relation d'un cas de myxome du sinus frontal compliqué de pansinusite droite, *Arch. belges du serv. de sante de l'armee* **91** 58 (March) 1938.

166 McAuliffe, G. W. Myxochondroma in the Nose of a Child Eight Months Old. Report of a Case, *Laryngoscope* **48** 206 (March) 1938.

167 Tsuruyama, K. Ein Fall von grossem blutendem aus der Kieferhöhle entspringendem Antrochoanalpolyp, *Nagasaki Igakkai Zasshi* **16** 2277 (Sept.) 1938.

168 Silbernagel, C. E. Lipoma of the Maxillary Antrum, *Laryngoscope* **48** 427 (June) 1938.

Castañeda and Marques¹⁶⁹ describe in detail the clinical course of a reticuloplasmocytoma of the frontal region in a man of 62 and discuss the histopathologic observations at length. There was a history of trauma several months previously, causing a swelling, which was diagnosed as a hematoma and incised. The tumor continued to grow and when seen by the authors presented as a mass the size of a mandarin orange, surmounted by a gaping wound, from which a fungating friable mass protruded which was a violaceous or wine red color. The skin was attached, and the tumor seemed adherent to the bone, which was shown by a roentgenogram to be partially absorbed. In addition roentgenograms revealed areas of decalcification in the temporal bone, maxilla, humerus and coccyx. The blood picture was as follows: red cells, 2,900,000, white cells, 10,000, polymorphonuclears, 60 per cent, monocytes, 30 per cent, plasmocytes, 5 per cent, and eosinophils, 2 per cent. Biopsy confirmed the diagnosis. The outcome was fatal.

Mathers and Cappell¹⁷⁰ report the rather rare case of a giant cell tumor of the frontal bone discovered as the first manifestation of osteitis fibrosa. The tumor was observed in a woman of 40, who complained of headache coincident with the appearance of a rapidly growing mass in the left frontal region, over a period of three months. Roentgenograms revealed a mass obliterating the sinus as well as changes in other skeletal bones. The blood calcium was high and the phosphorus low. Also there was increased calcium in the urine. Operation disclosed a soft red mass filling the sinus, eroding its posterior wall and exposing the dura. Later an adenoma of the left parathyroid was removed, following which the bony changes were arrested and normal calcification ensued. No postoperative tetany was observed. Pictures of some interesting histologic sections accompanying the article add much to its value.

SURGICAL TREATMENT

General Observations—Skillern¹⁷¹ discusses the persistence of pain following multiple operations on sinuses from the standpoint of his own experience and the responses to a questionnaire addressed to 16 experienced rhinologists. The latter elicited a wide variety of explanations, which included items such as "injury to the sympathetic nerves," "diversion of air currents," "atypical neuralgia," "synechiae," "incomplete operation" and so on. Certainly there was a lack of unanimity in the responses. The author himself believes that persisting pains are due

169 Castañeda, M., and Marques, J. Un caso de reticulo-plasma citoma del frontal, *Rev. med., Peruana* **9** 547 (Nov.) 1937.

170 Mathers, R. P., and Cappell, D. F. Osteoclastoma of the Frontal Bone in Hyperparathyroidism, *J. Laryng. & Otol.* **53** 656 (Oct.) 1938.

171 Skillern, S. R., Jr. The Persistence of Pain Following Multiple Operations for the Cure of Sinus Disease, *Pennsylvania M. J.* **41** 1017 (Aug.) 1938.

to traumatism to bone and periosteum, failure to remove all diseased tissue, reinfection of previously healed cavities, injury to sympathetic nerve fibers, localized osteomyelitis or meningitis and postoperative synechiae

Russell¹⁷² states that the absence of pus in chronic sinusitis may not indicate a receding infection. He believes that imprisoned edema (sub-epithelial) is the essential lesion in the maintenance of chronic infection. This is due "to increased osmotic pressure caused by the breaking down of large colloidal molecules into small ones. This pressure can be higher than the blood pressure, being the probable cause of the death of the mucous membrane." Another cause of persisting infection is chronic osteitis. As to indications for surgical intervention, the author believes that polypoid degeneration unassociated with suppuration requires more radical surgical treatment than the simple suppurative type, which often yields to drainage and ventilation. When the antrum, ethmoid labyrinth and sphenoid sinus are all affected, he favors the Morgan operation of cavitation, in which the Caldwell-Luc procedure is amplified by removal of the entire nasoastral wall, including the middle and inferior turbinates. The ethmoid cells and sphenoid sinus are cleaned out via the antral opening. Whenever possible, the mucosa of the nasoastral wall is preserved and reflected as a flap into the antrum. Pain and postoperative swelling are marked for about a week, but the pain can be minimized by carefully suturing the periosteum in the sublabial incision. This particular operation is recommended for patients with chronic conditions previously operated on by other methods, especially patients suffering from headaches, asthma and other debilitating conditions. Commenting on the Ferris-Smith operation, the author states that he has followed 9 cases since 1935. In 2 cases there were persistent crusting and discomfort. Diplopia lasted twelve months in another. In 4 cases there were crusting, discharge, pain and retention of secretions. In 2 cases another operation had to be done because of stenosis.

Cunning's¹⁷³ experience leads him to make the following observations. The middle turbinate may be inflected as a routine in cases of acute infection for the relief of pain. Occasionally he has found it necessary to resect the anterior end of the middle turbinate. When orbital symptoms are present, he advises conservative treatment, unless bulbar mobility is impaired. In the presence of chronic cough he will operate on a sinus only if there are definite indications of pathologic alteration. He prefers to open the antrum intranasally and the ethmoid-frontal group by the Lynch procedure. In recent years he has operated

172 Russell, B. The Operative Treatment of Chronic Sinus Infection, *Proc Roy Soc Med* **31** 226 (Jan) 1938

173 Cuning, D. S. Surgical Indications in Sinusitis, *Laryngoscope* **48** 429 (June) 1938

less frequently for retrobulbar neuritis than formerly, having found that the focus could be established to be elsewhere than in the sinuses

Hill¹⁷⁴ found that methylene blue injected into the infraorbital canal of the cadaver was diffused through the sphenopalatine ganglion and its palatal branches. It even penetrated as far as the gasserian ganglion but did not infiltrate into the orbit. He has found in practice that injection of an anesthetic into this nerve was extremely helpful in obtaining anesthesia for intranasal ethmoidectomy and window resection of the antrum. He uses a 22 gage needle introduced directly through the skin. A few drops are injected superficially at first and then more deeply. "After a minute or so the needle is advanced into the foramen to its full length and locked in by pressure of the first and second fingers of the left hand straddling the butt of the needle. From 2 to 2.5 cm. of the solution of procaine hydrochloride is slowly injected, the operator taking five minutes to complete the injection." The procedure is sufficient also for a Caldwell-Luc operation, except for the superficial injection, along the line of incision. Also it is necessary to block the branch of the nasal nerve which comes from the ophthalmic branch of the fifth cranial nerve. This is done by injecting the anesthetic into the anterior ethmoid foramen along the nasal wall of the orbit.

Operations on the Maxillary Sinus—von Bajkay¹⁷⁵ contributes a long dissertation covering every phase of surgery of the antrum. In cases of acute infection he has found it possible to cannulize the antrum through the natural opening in only 10 per cent of cases, which is quite at variance with the statistics of Van Alyea, Rosenberger and Meyerson. In cases of chronic sinusitis, if frequent irrigations by puncture over a period of four to five weeks fail to clear up the condition, he does an intranasal window operation of the Claoue-Lathrop type. In 108 of 287 such cases it was necessary at the same time to resect the middle turbinate and open the other sinuses which were simultaneously affected. Apparently the results were not all satisfactory, since it was necessary at a later date to perform a radical operation on 58 patients, in 26 of these the antial inflammation was combined with disease of other sinuses. All of these patients were cured except 2. The author prefers the Denker to the Caldwell-Luc operation when it is necessary to operate on both the antrum and the ethmoid cells because it affords an easier approach to the latter. Unless there are serious complications, he prefers leaving the frontal sinus alone, since he has observed that it frequently clears up spontaneously after the antrum and ethmoid labyrinth

174 Hill, F. T. Local Anesthesia for Surgical Treatment of the Sinuses, *Arch Otolaryng* **27** 197 (Feb.) 1938

175 von Bajkay, T. Beiträge zur Chirurgie der Kieferhöhle, Hals-, Nasen- u. Ohrenarzt (Teil 2) **47** 1 (Aug., no. 1), 49 (Aug., no. 2) 1938

have been cleaned out. In his experience the most frequent causes of recurrence are an inadequate nasointestinal fistula, incomplete removal of lining membrane and insufficient surgical work on the other sinuses.

Bettington¹⁷⁶ states that chronic disease of the lining of an antrum will not yield to an intranasal operation. Furthermore, it is his belief that those patients who recover following the latter procedure would in all probability get well anyway if irrigations were persistently carried out. Also he believes it is necessary to remove all of the lining, since one cannot tell macroscopically where the diseased area ends and the healthy mucosa begins. He is against the use of postoperative packing and advises as little irrigation as possible.

Discussing the radical operation on the antrum, Alden¹⁷⁷ offers several hints as to procedures which have proved helpful to him. He suggests examination of smears and culture of the discharge prior to operation, since a knowledge of the bacterial flora present may assist the therapy. For instance, if Vincent's organisms are present, he gives arsphenamine, if streptococci, sulfanilamide, and if staphylococci, he worries about the possibility of subsequent osteomyelitis. He finds Blau's method of blocking the second division of the trigeminal nerve effective in obtaining anesthesia. Also he prefers a triangular incision in which the vertical arm is projected upward for an inch (2.5 cm.) in the space between the lateral incision and the canine teeth.

In evaluating the worth of a procedure Millar¹⁷⁸ finds that a questionnaire alone is inadequate and unreliable. He prefers to draw conclusions only after examining the patient himself and studying the postoperative roentgen pictures. Of 85 patients subjected to intranasal antrostomy and examined from two to six years later, 50 per cent still showed gross swelling of the mucosa, 21 per cent moderate swelling and 13 per cent slight swelling. A large percentage also still complained of nasal discharge. The author feels that patients whose sinusitis does not yield to lavage will not recover completely unless a radical operation is performed in which the mucosa is entirely removed.

Moreaux¹⁷⁹ takes a more conservative stand, reporting cures in 31 of 38 patients operated on by the intranasal route. The remainder had to undergo a radical operation at a later date because of persisting symptoms. The author remarks that where the indications point definitely

176 Bettington, R. H. Some Aspects of Maxillary Antrum Infection, *M. J. Australia* **1** 853 (May 14) 1938.

177 Alden, A. M. The External Operation on the Maxillary Sinus, *South M. J.* **31** 282 (March) 1938.

178 Millar, T. G. Endonasal Antrostomy. An X-Ray Study, *M. J. Australia* **25** 689 (Oct. 22) 1938.

179 Moreaux, R. Resultats de l'operation de Claoue, *Oto-rhino-laryng internat.* **22** 203 (April) 1938.

to the presence of polyposis or fungoid vegetations within the sinus, or when the infection is of dental origin or when needle puncture cannot be carried out because of the thickness of the bone it is advisable to proceed at once to a radical operation

Rentschler¹⁸⁰ claims that 49 of 64 patients were cured by the intranasal operation. He states that it is necessary to make the window large enough to permit reflection of a mucous membrane flap into the sinus. To obtain freer access to the nasoantral wall, he advises removing part of the inferior turbinate.

Grove¹⁸¹ reports a case in which paralysis of the external rectus and inferior oblique muscles of the eye followed a radical operation on the antrum in which an attempt was made to enter the ethmoid labyrinth transantrally. The patient was under general anesthesia. He believes the nerves were traumatized through a defect in the floor of the orbit. An orbital hematoma resulted with exophthalmos in addition to the paralysis mentioned. The ocular symptoms disappeared only in part. Two and a half years later diplopia was still present when the patient looked in the direction of the affected rectus muscle.

Fuller¹⁸² observed an unusual complication following a Caldwell-Luc operation in a woman of 58. The operation and immediate postoperative course were uneventful. One year later, however, there was complete atrophy of all the soft tissues of the face on the side of the operation. The nasoantral fistula was closed. In the subsequent year or so the patient gained some weight, and the face was somewhat improved. The author canvassed a number of leading rhinologists on the subject but obtained no satisfactory explanation of the phenomenon.

Figi¹⁸³ explains the methods of plastic repair of defects of the face following radical surgical operation on the antrum in cases of malignant growth as carried out at the Mayo Clinic. These reparative procedures are not undertaken until at least one year has elapsed after the healing of the primary operation. In men he uses a tubed flap from the back or the chest and in women a frontotemporal flap. The lower margin of the orbit is built up later by the insertion of a strip of bone taken from the crest of the ilium and held in place by a pin or else by a costal cartilage graft. Gingival or palatal defects are taken care of by proper

180 Rentschler, H. D. Some Observations Concerning Chronic Maxillary Sinusitis. *Pennsylvania M. J.* **41** 975 (Aug) 1938.

181 Grove, R. C. Unusual Combination of Ocular Paralysis Following Radical Operation on the Antrum, *Arch. Otolaryng.* **27**:275 (March) 1938.

182 Fuller, T. E. Unusual Complication of Radical Antrum Operation, *South M. J.* **31** 1094 (Oct) 1938, Unusual Complication Following Caldwell-Luc Operation, *J. Arkansas M. Soc.* **34** 94 (Oct) 1937.

183 Figi, F. A. Plastic Repair After Removal of Extensive Malignant Tumors of the Antrum. *Arch. Otolaryng.* **28** 29 (July) 1938.

prostheses If the lip is distorted by scar contraction, it is released and an epithelial inlay employed to prevent recurrence Photographs showing excellent cosmetic results accompany the article

Mayer¹⁸⁴ has a special forceps for leveling the nasoastral wall in the intranasal operation By means of a shaft thin enough to pass under the inferior turbinate and a spiral housing near the end it is possible to set the jaws of the forceps at an angle of 90 degrees to the shaft, which facilitates the downward biting

Operations on the Frontal Sinus—Lillie¹⁸⁵ states that the type of operation indicated depends on the lesion present and the size and shape of the sinus In a small sinus the Jansen-Lynch type of procedure is usually sufficient If the anterior wall is diseased, the Killian operation may be necessary The deformity can often be minimized by beveling the bone so as to create a gradual slope into the excavated cavity An obliterating operation is advisable for patients living some distance from a medical center or patients for whom proper after-care is not available If it is desirable that the sinus cavity be maintained, the author suggests leaving the frontal process of the superior maxilla alone, as it prevents the collapse of the soft parts with possible obstruction of the duct He states also that the reason some sinuses obliterate readily while others tend to remain open may be found not only in the technic employed but also in the individual reaction to repair He prefers dry treatment in the after-care to frequent irrigations, reserving these only for occasional removal of clots In dealing with severe acute frontal sinusitis, Lillie prefers a simple external trephine opening to any intranasal attempts at establishing drainage, a most valuable suggestion which all rhinologists may well heed

Stone and Berger¹⁸⁶ offer a modification of Halle's intranasal operation in which flaps of mucoperichondrium are dissected downward from both sides of the septum just below and parallel to the nasal bridge The septum thus exposed is removed flush with the inner aspect of the nasal bones and floor of the frontal sinus The crista frontalis is removed by means of a burr attached to a Mueller pistol handle The sinus is entered and the intersinus septum removed At the conclusion of the operation the mucoperichondrial flaps are turned into the sinuses covering the denuded bone and forming a large common atrium into the nose from both sinuses

184 Mayer, O Eine Stanze fur die Kieferhohle, Arch f Ohren-, Nasen- u Kehlkopfh **144** 309, 1938

185 Lillie, H I External Operations on the Frontal Sinus, Am J Surg **42** 199 (Oct) 1938

186 Stone, F E, and Berger, M Chronic Frontal Sinusitis A New Endonasal Surgical Approach, Laryngoscope **48** 626 (Sept) 1938

Soderberg¹⁸⁷ reviews the history of mucous membrane flaps in frontal sinus surgery, crediting Killian with being the first to mention this point and Sourdille and Bárány with valuable contributions on the subject. The author prefers Bárány's technic, which he has modified slightly, and presents a number of excellent drawings illustrating the successive steps in the procedure. He reports on 120 patients operated on in this manner, 23 with acute and 96 with chronic sinusitis. Five patients died, 2 from acute phlegmon of the face, 1 from meningitis, 1 from osteomyelitis and 1 from septic angina. In addition there were 10 patients with other complications: 3 with lid abscess, 2 with severe nasal hemorrhage, 1 with erysipelas and 1 with angina. It is interesting to note that 20 of the patients with acute disease recovered completely and at a later date were found able to receive a 3 to 5 mm Ritter sound, 87 with chronic disease were followed up, and all were cured but 12. Of these, 3 still had subjective symptoms, in 2 the nasofrontal duct was impassable, in 2 others it was very small, and in 7 there was a persistent mucopurulent discharge.

Kofler¹⁸⁸ cites a case to show that occasionally severe frontal sinusitis may be cured by endonasal surgical treatment when apparently an external operation is indicated. A man of 41 had had a chronic infection of the frontal sinus for four years. In the beginning an acute attack was relieved by intensive local treatment, and the patient had few symptoms until a year ago, when acute rhinitis precipitated a recurrence. The complaint since then was of severe morning headache, slight swelling and tenderness at the floor of the sinus, purulent discharge and crusts. The author performed a transseptal resection of the cells of the agger nasi, reaching the frontoethmoid group and through them the floor of the frontal sinus. Much creamy pus was evacuated, and with appropriate after-care the patient was completely relieved, remaining free from symptoms while under observation for a two year period.

O'Connor¹⁸⁹ reports 2 cases in which marked frontal deformity after extensive surgical operation for osteomyelitis was corrected by a plastic surgical procedure. In the first case a rearrangement of the skin flaps achieved a good cosmetic result and in the second a cartilage isograft was successfully employed.

187 Soderberg, F. Beitrag zur Kenntnis der Bárány'schen Stirnhöhlenoperation, *Acta oto-laryng* 26 541, 1938.

188 Kofler, K. Rhinogene chronische Stirnhöhleneiterung mit paroxysmalen Stirnkopfschmerzen durch endonasale Operation geheilt, *Monatschr f Ohrenh* 72 990 (Oct) 1938.

189 O'Connor, G. B. Contour Reconstruction After External Frontal Sinus Operation, *Ann Otol. Rhin & Laryng* 47 183 (March) 1938.

Foster¹⁹⁰ used the full thickness of rib cartilage, a piece measuring $3\frac{1}{2}$ inches (9 cm) in length, to fill in a deep frontal depression following a bilateral obliterating operation. The graft was inserted through an incision at one end after tunneling under the skin all the way across to the other side.

Operations on Frontoethmoid, Ethmoid and Sphenoid Sinuses—Bryant¹⁹¹ describes the following anatomic factors which may make it difficult to maintain a patent nasofrontal passage: (1) anteroposterior deviation of the mesoethmoid portion of the nasal septum (a condition which requires a preliminary submucous resection), (2) very thin lamina papyracea and lacrimal bone which cannot be avoided in the ethmoid exenteration, (3) abnormal development of the cells of the agger nasi, (4) double frontal sinus on one side with two ostia (these should be united), (5) naturally narrow nasal cavities and thin nose. The author considers it important always to exenterate completely the cells of the agger nasi and to remove the backward projection of the spina nasofrontalis of the superior maxilla, as first pointed out by Halle.

Lodge¹⁹² suggests a median incision extending along the bridge of the nose and up in the midline of the frontal area, with the soft tissues and periosteum being dissected back on either side. He claims to be able thus to expose the floor of both frontal sinuses, the lacrimal areas and both laminae papyraceae, affording access to the frontal, ethmoid and maxillary sinuses.

Muskat¹⁹³ presents a general discussion of the pathologic features of involvement of the sinuses and the indications for surgical intervention with a description of the external frontoethmoid operation mainly along the lines proposed by Ferris-Smith.

Mangabeira-Albernaz¹⁹⁴ has done the transmaxillary ethmoid operation described by de Ermiro, of Lima, in 18 cases and is enthusiastic over it. It differs from the usual transantral operation in the fact that the nasoantral wall is resected submucously so as to avoid too large an opening into the nasal cavity with possible subsequent crusting. Also the author points out the necessity of following the cells upward to two definite points, viz., the angle formed by the lamina papyracea with the

190 Foster, B. Extreme Disfigurement Resulting from an Operation on the Frontal Sinus, Corrected with Graft of Rib Cartilage, Australian & New Zealand J. Surg. **8** 85 (July) 1938.

191 Bryant, F. L. The Nasofrontal Tract in the External Fronto-Ethmo-sphenoidectomy, Laryngoscope **47** 901 (Dec) 1937.

192 Lodge, W. O. Ueber beiderseitige Rhinotomie, Monatschrift Ohrenh. **72** 712 (July) 1938.

193 Muskat, I. Chronic Nasal Sinus Disease, Wisconsin M. J. **37** 997 (Nov) 1938.

194 Mangabeira-Albernaz, P. A operação de Ermiro de Lima (etmoidectomia transmaxilar submucosa), Rev. oto-laring. de São Paulo **5** 419 (Sept-Oct) 1937.

inferior wall of the orbit and the angle between it and the orbital roof. The middle turbinate is left in place, which protects the cribriform plate from possible injury.

Von Bajkay¹⁹⁵ presents a review of various surgical procedures employed in the treatment of chronic ethmoid and sphenoid disease, omitting reference to the external approach long popularized in this country. He seems to favor the intranasal operation, which was done on 341 patients. He claims that persistence of suppuration after this operation is due to failure to remove all of the ethmoid mucosa, which in some cases is especially difficult to accomplish in the infundibular region and in the frontal cells which extend to the orbital roof.

De Gennaro¹⁹⁶ discusses the various approaches to the sphenoid sinus in connection with his report of the removal of a bullet. The projectile had entered the hard palate near its posterior border, perforated the soft palate and fractured the septum, the posterior end of the inferior turbinate, the outer wall and floor of the sphenoid sinus, the intersinus septum and the posterior superior wall of the sinus. The resulting symptoms were (1) diabetes insipidus due to disturbance of the para-infundibular region from basilar contusion, (2) bilateral homonymous hemianopia from contusion of the left optic tract and (3) strabismus and diplopia from paralysis of the left external oculomotor nerve branch through its close connection with the contused base. The bullet was removed by a transpalatal approach following the tract it had made. The main mass was found deeply embedded in granulation tissue in the posterior superior wall of the sphenoid sinus. A secondary plastic operation was performed on the hard palate after the acute reaction had subsided.

Proetz,¹⁹⁷ observing a number of patients who had undergone operations on the sphenoid sinus returning year after year because of symptoms due to closure of the enlarged ostium, came to the conclusion that the condition was due to nature's efforts to close the abnormal opening because exposure of the delicate mucosa of the sinus to inspired air caused drying with subsequent pain and crusting. He has therefore modified his procedure in cases in which operation on the sphenoid sinus is indicated, by leaving the natural ostium alone and making an adventitious opening close to the septum with a keen Sluder knife and sharp cutting forceps. He does not find it necessary to bring the opening down to the floor of the sinus, where the bone is thick, since gravity

195 von Bajkay, T. Beiträge zur Chirurgie des Siebbeines und der Keilbeinhöhle, *Acta oto-laryng* 26 639, 1938.

196 de Gennaro, R. Vie di accesso al seno sfenoidale (contributo clinico), *Riv di chir* 4 71 (Feb) 1938.

197 Proetz, A. W. Nasal Physiology and Its Relation to the Surgery of the Accessory Nasal Sinuses, *Proc Roy Soc Med* 31 1405 (Oct) 1938.

does not contribute much to the drainage. He finds that this procedure permits adequate immediate drainage without impairing the utility of the natural ostium, which is left untouched.

NONSURGICAL THERAPY

General Observations—Coates¹⁹⁸ presents a thorough analysis of the various factors, local and constitutional, contributing to sinus disease. He offers some excellent advice on the local treatment of acute conditions, embracing a description of proper methods of establishing drainage without injury to the nasal mucosa. He emphasizes the importance of capillary suction as against mass suction and points out the dangers of the latter procedure except at the stage in which the Proetz displacement procedure is indicated. He also speaks well of Jarvis' treatment with insulin and iodine and discusses the rationale and the type of cases best suited to this therapy.

Mithoefer¹⁹⁹ emphasizes the role of constitutional factors in the persistence of nasal symptoms and the failure of surgical treatment. Among these are hypothyroidism, intestinal stasis, hypoglycemia and allergy. He cites painful areas (supraorbital, parietal, trapezius and sternomastoid) as evidence of constitutional disturbances which should be corrected before surgical intervention is undertaken. He speaks of the four tender points of Killian which frequently need to be cauterized. For hypersecretion of mucus he advises 3 units of insulin given two or three times per week. He prefers puncture of the middle meatus with a blunt cannula to the use of a sharp trocar below the inferior turbinate. Persisting pains radiating from the orbit after a radical operation on the antrum should suggest possible "silent osteitis about the alveolus," and the patient should be referred to a dentist.

Furstenberg²⁰⁰ states that sinus therapy at the University of Michigan for the past thirty years has been strictly conservative, and he quotes Canfield's caution to "avoid bone work in the presence of an acute infection." Trauma from puncture or even cannulization is avoided as well as trauma from irritating solutions, such as mercurochrome and those containing silver compounds, and from tampons. The means of treatment generally recommended are rest in bed, morphine or codeine for pain, plenty of fluids and nutritious food. Heat or cold may be employed locally, as well as steam vapor inhalations. Locally he uses

198 Coates, G. M., and Gordon, W. Nonsurgical Treatment of Acute and Chronic Sinus Disease with Operative Indications and Contraindications, *M. Clin. North America* **22** 1565 (Nov.) 1938.

199 Mithoefer, W. Pertinent Questions Relating to the Nasal Sinus Problem, *J. Med.* **19** 189 (June) 1938.

200 Furstenberg, A. C. The Treatment of Acute Nasal Accessory Sinus Disease, *Ann. Otol., Rhin. & Laryng.* **47** 902 (Dec.) 1938.

ephedrine 3 per cent in saline solution by instillation or by displacement. Serious complications may follow disregarding Canfield's dictum as evidenced by the fact that 42 of 58 consecutive patients with osteomyelitis gave a history of a preceding surgical attack made during acute sinusitis or acute exacerbation of chronic sinus disease. In 300 consecutive patients with acute sinusitis who were treated conservatively there was not a single orbital or osteomyelitic complication. These patients were hospitalized for an average of one week five days of which were spent in bed. All patients were reexamined six months to two years later and 296 were found asymptomatic and free from evidence of chronic sinus disease. The author advises irrigation only if the nasal discharge persists for three to six weeks after the acute attack.

Brown²⁰¹ being located in a region where many patients are sent by their physicians for climatic relief of symptoms referred to the sinuses is in a position to evaluate the effects of a warm, dry climate. Most of his paper is given over to a discussion of standard nonoperative procedures, as to the results of which he draws no conclusions. His inability to draw conclusions is probably due to the fact that many of the patients are transients. It would be interesting to learn if possible just what the long run effects would be in these patients who have been operated on repeatedly without result.

Irrigation-Suction—Skoog²⁰² claims that damage may result from mass suction although in most cases it is harmless. As a rule negative pressure if too light fails to reach the interior of the sinus and if too strong may cause swelling of the mucosa about the ostium, with closure. Furthermore, the author has observed a submucous hematoma result from suction of the sphenoid sinus.

Andersen²⁰³ substantiates Skoog's argument by various experiments proving that it is impossible to empty the antrum by suction the hiatus semilunaris becoming closed off during the procedure.

Lejeune and Laoureux²⁰⁴ present a detailed description of Proetz's displacement technic with the modifications introduced by LeMee. They use neiodipin (Merck) 20 per cent an iodized oil which is satisfactory for contrast studies and therapeutically beneficial. Among the dangers of the procedures they mention otitis media and pansinusitis citing 2 cases of the former with subsequent mastoiditis and 1 case of acute

201 Brown E. H. Conservative Management of Sinus Trouble. *Southwestern Med.* 22:140 (April) 1938.

202 Skoog, T. Some Viewpoints on Suction Treatment of Diseases of the Accessory Sinuses, *Nord. med. tidskr.* 16:1045 (July 2) 1938.

203 Andersen H. C. Suction in Maxillary Sinusitis. *Nord. med. tidskr.* 16:1050 (July 2) 1938.

204 Lejeune-Laoureux J. Diagnostic et traitement médical des sinusites par la méthode de déplacement ou de Proetz. *Liege méd.* 31:357 (April 3) 1938.

frontal sinusitis. Also headache, hemorrhage and the appearance of polypi were noted as a result of too much negative pressure.

Haardt²⁰⁵ finds irrigations by puncture satisfactory for most chronic infections of the antrum except those due to a dental focus. The procedure is carried out every three days up to three or four weeks. If at this time the discharge still persists, the irrigations are discontinued for two weeks. In many cases the antrum seems to clear up. If it fails to do so, the cases are considered surgical, and operation is performed. For children he advises one thorough irrigation performed with the patient under general anesthesia. He has found that young adults just recovering from a cold who complain of an uncomfortable pressure or pain at the root of the nose may be completely relieved by a puncture irrigation even though no secretion is obtained.

Futch²⁰⁶ has cannulized the antrum by way of the middle meatus in 1,200 cases in the past four years, constituting 72 per cent of all cases in which irrigations were done. He claims that in 40 per cent the cannulation was done through the natural ostium, and in 30 per cent, through an accessory opening. He describes the technic and reviews the work of previous authors on this subject.

Van Alyea²⁰⁷ recommends irrigation of the frontal sinus for acute conditions if after forty-eight hours the temperature is normal. In subacute conditions with stuffy nose, discharge and cough, he advises a submucous resection and infraction of the middle turbinate preliminary to the irrigation, which may be repeated six to eight times. Early chronic conditions (three to eight months) require the same treatment, but the number of irrigations may have to be extended to as many as twenty. Chronic conditions of longer standing require in addition an enlarging of the natural ostium. Recurring attacks may be relieved by one irrigation but usually need surgical treatment. The author has seen no bad results from irrigation and claims on the basis of 200 specimens studied as well as clinical experience that a high percentage of ostiums can be probed for irrigation.

Watkins²⁰⁸ shrinks the middle turbinate with neosynephrin hydrochloride, puts the patient in a Ritter dental chair with the head low or in the Rose position and fills the nasal cavities with a 1 per cent solution

205 Haardt, W. Zur Spülbehandlung der Kieferhöhlenentzündung, Arch f. Ohren-, Nasen- u. Kehlkopfh. **144** 307, 1938.

206 Futch, C. E. Maxillary Sinus Irrigation Through the Ostia, with Anatomical and Clinical Demonstrations, California & West Med **48** 438 (June) 1938.

207 Van Alyea, O. E. Study of Frontal Sinus Ostium, Ann Otol, Rhin & Laryng **47** 1116 (Dec.) 1938.

208 Watkins, S. Medical Treatment of Pyogenic Inflammation of the Nose and Nasal Accessory Sinuses, Kentucky M. J. **36** 554 (Dec.) 1938.

of sodium chloride, sodium bicarbonate and dextrose, which he allows to remain for about two minutes. The patient is then instructed to hawk the solution into the throat and sit up. Partial suction is obtained by closing one nostril at a time during the hawking process.

Gurtov²⁰⁹ has a new instrument for suction-irrigation with which it is possible to irrigate both sides of the nose without making the nares airtight. This feature eliminates gagging, blockade of the eustachian tube and pain. Either side can be irrigated alone or both sides simultaneously.

Use of Drugs and Vaccines—Coates, Davis and Gordon²¹⁰ report good results from the use of a preparation called camniol, which consists of camphor 2 per cent, menthol 4 per cent and antimony iodide 0.1 per cent. It is given subcutaneously or intramuscularly in 1 cc ampules daily for four days and then semiweekly until improvement. In 284 cases of acute, subacute and chronic sinusitis of all types which resisted other treatment these injections were given, and very gratifying results were obtained in 32 per cent, beneficial results in 30 per cent, uncertain in 26 per cent and unsatisfactory in 2 per cent.

Calcium cevitate (ascorbate), a calcium salt of vitamin C, is offered by Ruskin²¹¹ as an effective remedy for acute respiratory infections and practically abortive for the common cold. Each 3 cc ampule (15 per cent solution) contains 450 mg of vitamin C and a calcium content of about 11 per cent. In a series of 100 cases 42 per cent were completely relieved after the first or second injection and 35 per cent markedly improved.

Fletcher²¹² is a firm believer in the efficacy of algyrol tampons applied in the region of the sinus ostiums as a means of promoting drainage. He also recommends vapor inhalations carrying menthol and camphor.

Lemon²¹³ describes the use of Krueger's undenatured vaccine in the treatment of chronic sinusitis and cites a series of 40 cases in which this treatment was given at Temple University. These patients received an average of twenty-nine injections over a period of about four months.

209 Gurtov, J. J. A New Instrument for Suction-Irrigation in the Treatment of Paranasal Sinusitis, *Laryngoscope* **48** 286 (April) 1938.

210 Coates, G. M., Davis, W. B., and Gordon, W. The Parenteral Administration of Certain Substances in Upper Respiratory Infections, *Ann. Otol., Rhin. & Laryng.* **47** 473 (June) 1938.

211 Ruskin, S. L. Calcium Cevitate in the Treatment of Acute Rhinitis, *Ann. Otol., Rhin. & Laryng.* **47** 502 (June) 1938.

212 Fletcher, W. The Sinuses as Points of Focal Infection and the Treatment of Sinusitis, *Laryngoscope* **48** 17 (Jan.) 1938.

213 Lemon, A. N. Use of Undenatured Bacterial Antigen in Chronic Suppurative Sinusitis, *Laryngoscope* **48** 420 (June) 1938.

In 72 per cent satisfactory improvement was noted after other means of therapy, aside from surgical, had been tried. The initial dose given is 0.1 cc intradermally and 0.1 cc subcutaneously. At intervals of three to five days the latter dose is increased by 0.1 cc each time, up to a maximum of 1 cc, after which it is repeated at weekly intervals. In addition these patients received cleansing treatment followed by the topical application of 1 to 1.5 cc of antigen diluted with 0.5 per cent ephedrine solution, introduced by the Piroetz method.

Shorell²¹⁴ uses a combination of autogenous vaccine combined with a 2 per cent solution of histadine and claims to have obtained cures in 80 per cent of his patients with chronic sinusitis. The only additional therapy employed is the local use of heat, which is applied by means of hot water circulating through a half-inch (1.3 cm) rubber tube inserted into the nasal cavities. The temperature of the water is gradually raised from 112 to 128 F and maintained for fifteen to twenty minutes.

Physical Therapy and Roentgen Irradiation—Butler and Woolley²¹⁵ review their experiences with roentgen treatment of sinusitis since their first publication on this subject in 1934. They explain their good results as being due to early destruction of lymphocytes with liberation of antitoxic substances together with an early appearance of macrophages in great numbers. They claim to have proved this by histologic examination of sinus mucosa removed from experimental animals so treated. They state that this reaction accounts for the increase of discharge when the treatment is first started. They do not hold the treatment applicable to acute conditions, cysts, polypus or syphilis. Also they have found roentgen rays to have little effect on fibrotic tissue. The technical details of the treatment are given in detail. It is noteworthy that they have lately been using a higher voltage than formerly.

Hodges²¹⁶ also believes that roentgen rays in destroying lymphocytes release some vital ferment or antibody which combats infection. He advises using them to clear up acute conditions that fail to resolve spontaneously and recommends the treatment even for children. A second type of disease that has yielded good results is silent sinusitis associated with nonspecific pulmonary disease. He believes it is safe and proper to try the treatment for chronic fibrotic or polypoid changes before resorting to surgical operation, since in many instances clinical improvement has been noted.

214 Shorell, I. D. A New Therapy in Chronic Sinusitis, *M. Rec.* **148** 55 (July 20) 1938.

215 Butler, F. E., and Woolley, I. M. The Roentgen Treatment of Chronic Sinusitis, *Radiology* **30** 686 (June) 1938.

216 Hodges, F. M. Roentgen Therapy of Infections of the Nasal Accessory Sinuses, *Am. J. Roentgenol.* **39** 578 (April) 1938.

Smith and Nickel²¹⁷ employing a slightly different technique from that of Butler and Woolley report on 25 patients so treated. These are divided into three groups as follows: (1) those with the usual symptoms of sinusitis plus a large quantity of thin watery discharge and a red swollen, dripping mucosa presenting the appearance of acute vasomotor rhinitis; (2) those previously operated on with partial relief and persisting discharge; (3) those with heavy catarrhal postnasal drip, headache and boggy membranes. Seven patients in group 1 showed 100 per cent good results following roentgen treatment. In group 2 improvement was noted in 7 of 8 patients. The results in group 3 were less encouraging.

Popp²¹⁸ claims excellent results from roentgen treatment in both acute and chronic sinusitis. In cases of the former he gives up to 600 r in divided doses. There is a primary reaction with fever and increased discharge which is promptly followed by rapid clearing up of all symptoms. In 10 of 18 cases of chronic sinusitis there had been resistance to all previous treatment. In 6 of these roentgen rays had cured and in 4 had greatly improved the condition. In the other 8 operation had to be resorted to. In cases of chronic sinusitis the author gives from 1,000 to 2,000 r in divided doses at intervals of two days.

Mitchell²¹⁹ reports 2 cases in which chronic sinusitis was clinically cured by roentgen rays although the subsequent pictures failed to show any clearing of the shadow.

Troup²²⁰ makes a plea for physical therapy in cases in which chronic sinusitis has resisted other measures including surgical. He points out the importance of starting with small doses to avoid an unfavorable initial reaction. He finds that the ultra short wave is more likely to give rise to toxic symptoms than infra-red radiation. Much of the paper is taken up with technical details.

In a discussion before the Royal Society of Medicine on physical therapy Zamora²²¹ after explaining the action of various currents and their general uses concludes by saying that 'physical measures do not

217 Smith, H. B., and Nickel, A. C. The Treatment of Subacute and Chronic Sinusitis by Roentgen Radiation. *Am J Roentgenol* **39**:271 (Feb) 1938.

218 Popp, L. Roentgenotherapy of Sinusitis, *România med* **16** 277 (Nov. 1) 1938.

219 Mitchell, H. X-Ray Therapy in Sinusitis, *M. J. Australia* **2**:86 (July 16) 1938.

220 Troup, W. A. The Treatment of Sinusitis by Radiotherapy. *Brit J Phys Med* **1** 158 (May) 1938.

221 Zamora, A. M. Discussion on the Value of Physical Methods in the Treatment of Suppurative Conditions of the Nose and Throat, *Proc Roy Soc Med* **31**:883 (June) 1938.

materially alter the classical indications for operation and the problems of treatment remain those of mechanical drainage" Heald believes that exaggerated claims for short wave treatment have done the procedure harm. It is of value only in cases of recurrent sinusitis "when adequate drainage exists or where the chronic nature of the condition means rather that there is an inadequate blood supply to the infected lining mucous membrane" Foister wisely remarks that "the difficulty in assessing the value of treatment (short wave) lies in the fact that the majority of these cases (acute sinusitis) react well without the short wave therapy under similar circumstances" Troup in a period of nine months treated 20 patients who had undergone two or more operations without relief. He used the infra-red radiation, with relief in nearly all of them, and attributes the beneficial results to improved blood and lymph flow. Incidentally he administered a diet rich in vitamin B as well as the drug itself. Friel showed a method of entering the antrum through the inferior meatus by means of zinc electrolysis. "A puncture was made well back under the inferior turbinate by a stout zinc or brass wire or by a still rod the pointed end of which was coated with zinc. This formed the positive electrode while the negative was placed on the arm. When the current was turned on a ring of tissue around the wire was coagulated and destroyed."

Miscellaneous Observations—Shurly,²²² while advocating the use of vitamins begun early in life as a prophylactic against sinusitis, cautions against their use to excess. He quotes Steck that hypervitaminosis D may cause intoxication and symptoms of parathyroidism.

Glas,²²³ commenting on an article by Whiteman concerning the relief from tinnitus afforded by bilateral antrotomy with lavage followed by menthol inhalations, states that he has made the same observation numerous times. He noted relief from tinnitus and cure of tubal catarrh in a number of cases following his antrum operation but failed to see any connection between the two. Since Whiteman's publication he recalled an article by some Russian author quoted by Zytowitsch in which it was observed that following an antrum operation in certain cases of multiple sclerosis the mobility of the extremities was restored and in 1 case protracted tinnitus was relieved. The author attributed the phenomenon to the effects of the procaine hydrochloride block. Glas thinks that the improvement in the ventilation of the eustachian tube is the more reasonable explanation.

²²² Shurly, B. R. Dietary Treatment of Chronic Sinusitis, *Am J Surg* 42: 174 (Oct) 1938.

²²³ Glas, E. Neue Therapie für Schwerhörige, *Wien med Wchnschr* 88: 146 (Feb 5) 1938.

Meyer ²²⁴ seems to think that infection in the teeth, tonsils and sinuses causes secondary jugular phlebitis, which he recognizes by tenderness to pressure along the vein. Having obtained good results from the use of leeches applied over the course of the vein, he argues that the treatment should benefit patients with chronic sinusitis. He believes that chronic phlebitis results in narrowing of the lumen, causing stasis and backing up of blood in the contributing veins. He applies three to five leeches over each side, and when they fall off he lets the wounds bleed for eight hours. If tenderness persists, the procedure is repeated in fourteen days. No data as to the type of sinusitis believed to be affected or the subsequent course are offered.

CLINICAL STUDIES

General Observations—Edmunds ²²⁵ feels that the public has been led to lay too much stress on vague and irregular nose and throat symptoms and in many instances have been the victims of overtreatment. Too much emphasis has been placed on the sinuses as sources of focal infection, resulting in needless worry, often resulting in neuroses. The author believes that otolaryngologists should assist in encouraging a more rational attitude among the laity and should employ the term "sinusitis" only when sufficient local pathologic alteration is present to justify extensive treatment or surgical intervention.

Payne ²²⁶ is also conscious of a pessimistic attitude toward the sinuses, which he would like to see dispelled. He believes that unsuccessful surgical treatment may often be laid to overlooked allergic or endocrine factors.

Fox ²²⁷ considers the factors entering into sinusitis as intrinsic or extrinsic. Among the former are listed heredity, endocrine disorders, allergy, tonsillar conditions, adenoids and dietary insufficiency, and among the latter, changeable weather, dust, lack of sunshine, cold storage, poor ventilation, drafts and swimming. Common sense and careful study in each case are necessary for proper evaluation and elimination of these various factors.

224 Meyer, O. Latente Jugularphlebitis als Ursache von Sinusitis, *Therap d Gegenw* **79** 333 (July) 1938.

225 Edmunds, M. Are We Too Sinus Conscious? *Virginia M Monthly* **65** 255 (May) 1938.

226 Payne, V. L. The Modern Concept of Sinus Surgery "Versus" the Old Idea, Once a Sinus, Always a Sinus, *Mississippi Doctor* **15** 58 (April) 1938.

227 Fox, C. C. Predisposing Factors and Preventive Measures in Sinusitis, *Pennsylvania M J* **41** 687 (May) 1938.

Heitger²²⁸ gives an adequate resume of the information the general practitioner should possess with regard to the sinuses. He rightly observes that the terms "conservative" and "radical" as applied to surgical treatment are misleading and suggests the words "complete" or "adequate."

Koebbe²²⁹ also covers the ground in much the same manner, and both his and Heitger's papers should prove welcome to the general practitioner.

Harris²³⁰ is impressed with the importance of a balanced diet and endocrine therapy, particularly for children. He deplors the failure in many instances to have proper roentgen studies of the sinuses made in medical cases in which a focus of infection is suspected.

Poole²³¹ proposes the following rules for the prevention of colds and sinusitis: 1 Don't go outdoors bareheaded. 2 Don't wet the hair and then go outdoors. 3 Protect the feet. 4 Don't sleep with the head uncovered to cold air or drafts. 5 Don't drink hard water to excess. 6 Don't sleep with the mouth open; use a "silent sleeper." 7 Don't be in a hurry; avoid fatigue. 8 Don't eat acid fruit in cold weather. 9 Avoid excessive exposure to cold.

Fawcett²³² presents a conservative outlook on sinusitis, based on a knowledge of nasal physiology, which is in line with the article just quoted and is typical of a growing appreciation of the work of Proetz, Hilding, Fenton and others.

Houser's²³³ article is of a similar trend, with emphasis on the necessity of properly evaluating pain as a symptom with reference to its location, time of onset, duration, etc.

Seletz²³⁴ presentation follows a similar pattern. In addition he points out the influence of climate and humidity on nasal function and the possibilities of predisposing to infection.

228 Heitger, J. D. What the General Practitioner Should Know About the Histopathology of the Nasal Accessory Sinuses. Its Use as an Index and Guide in the Diagnosis and Management of Nasal Sinus Disease, Kentucky M. J. **36** 108 (March) 1938.

229 Koebbe, E. E. Common Intranasal and Sinus Pathology, Nebraska M. J. **23** 24 (Jan) 1938.

230 Harris, J. H. The High Spots of Sinus Trouble in the Practice of Medicine, Mississippi Doctor, **16** 14 (Aug) 1938.

231 Poole, T. A. Sinusitis, Office and Home Care, Virginia M. Monthly **65** 543 (Sept) 1938.

232 Fawcett, K. R. Sinusitis, Minnesota Med. **21** 112 (Feb) 1938.

233 Houser, K. M. Acute Sinusitis, Pennsylvania M. J. **41** 690 (May) 1938.

234 Seletz, A. A. The Nose and Its Owner, West Virginia M. J. **34** 419 (Sept) 1938.

White²³⁵ calls attention to myalgic pains in the head and neck muscles, which are often assumed by the laity to indicate sinus infection. He points out the necessity for proper diagnosis in such cases.

Robison²³⁶ is conscious of errors in treatment, particularly surgical, which are responsible for unsatisfactory end results and emphasizes the importance of differentiating between true sinus infection and allergy in order to avoid damaging true functioning nasal tissue.

A series of experimental studies on guinea pigs by Taylor and Dyrenforth²³⁷ yielded valuable data pertaining to the harmful effects of chilling without compensation. The peripheral vasoconstriction with attendant stasis and anoxemia leads to a lowered leukocytic response and impaired phagocytic power of the resident tissue cells. Such changes predispose to infections in the upper respiratory passages.

Jowett²³⁸ attempts to establish criteria which will enable one to offer a satisfactory prognosis. While he believes that otolaryngologists possess adequate means of determining the degree of a given pathologic process in a sinus, "it is not yet possible to give accurate prognosis or indications for a given conservative or radical method of treatment in any particular instance, as impartial observations upon results of treatment are regrettably sparse."

Daviess,²³⁹ assistant professor of physical and health education at the University of Cincinnati, states that proper breathing will in most cases safeguard the swimmer against ear and sinus infection. She explains that inhaling through the mouth and exhaling through the mouth and nose simultaneously will avoid undue pressure of air and water such as might occur when exhaling through the nose alone. She also cautions the diver against exhaling until he has reached the surface of the water.

Von Bajkay²⁴⁰ presents a review of ten years' material seen in the Budapest Rhinolaryngologic Clinic, with a statistical analysis of the cases of sinusitis. Out of a total of 56,242 patients, 13,490 underwent

235 White, F. W. Acute Sinus Infections, New York State J. Med. **38** 982 (July 1) 1938.

236 Robison, J. M. Nasal Physiology and Its Relation to Sinus Surgery, Texas State J. Med. **34** 434 (Oct.) 1938.

237 Taylor, H. M., and Dyrenforth, L. Y. Chilling of the Body Surfaces. Its Relationship to Aural and Sinus Infections, J. A. M. A. **111** 1744 (Nov. 5) 1938.

238 Jowett, R. E. The Relationship of Sinus Infection to General Disease, M. Press **99** 78 (July 27) 1938.

239 Daviess, G. B. Sinusitis and Ear Infections as Related to Swimming and Diving, J. Health & Phys. Educ. **9** 308 (May) 1938.

240 von Bajkay, T. V. Bericht über das Operationsmaterial der letzten zehn Jahre und dessen interessantere Fälle an der Budapester Rhino-Laryngologischen Klinik, Monatschr. f. Ohrenh. **72** 56 (Jan.) 1938.

various operative procedures. Eighty per cent of those with acute maxillary infection were treated conservatively. In a series of 1,279 antrum punctures there were only 4 followed by complications, viz, 1 by acute otitis media, 2 by injury to the facial wall, with emphysema, and 1 by orbital infection from injury to the orbital floor. The results from their operative procedures were comparable to those of other large clinics.

Murakami²⁴¹ reports on 4 children with diphtheria of the sinuses who recovered after injection of anatoxin three times weekly for two weeks.

Role of Dental Infections—Voss²⁴² attempts to show by roentgen studies and clinical histories that multiple sinusitis or pansinusitis is never the direct result of a purely dental infection. He seems to think that suppuration in the antrum accompanying a dental infection is really a pyosinus or at most a definitely localized infection that will clear up when the dental focus is removed. When pansinusitis is present, he believes the factors to be chiefly intranasal, predating the dental infection, which serves only as the exciting agent. Histologic examination in purely dental cases shows that the pathologic process in the antrum is localized to the immediate vicinity of the affected tooth, while the remainder of the mucosa is only secondarily and mildly engorged. The secretion originates in the locally diseased portion and leads to an accumulation of foul pus due to anaerobes.

Fischer²⁴³ takes issue with Voss on this point and cites innumerable cases in which there is absolutely no history of previous sinus trouble or acute respiratory infection. Furthermore, the nasal discharge is the same foul type found about the dental socket after extraction, and treatment of the sinus empyema is fruitless unless the dental focus is eliminated, finally spontaneous cure takes place in many cases solely as a result of proper attention to the alveolus.

Shea²⁴⁴ offers some practical suggestions on the care of sinus infections due to infected teeth. If the antrum has been penetrated as a result of an extraction, the procedure is thorough cleansing and watchful waiting. Should the antrum become infected, it should be treated via an intranasal opening. He again cautions dentists against the vicious

241 Murakami, M. Erfolg des Anatoxins gegen Nasenhohldiphtherie und über die Immunität der Diphtherie, Oto-rhino-laryng **11** 126 (Feb.) 1938.

242 Voss, O. Gibt es ein dentales Kieferhohlenempyem? Arch f Ohren-, Nasen- u Kehlkopfh **144** 113, 1937.

243 Fischer, C. H. Gibt es ein dentales Kieferhohlenempyem? (Eine Stellungnahme zu dem Artikel von O. Voss), Arch f Ohren-, Nasen- u Kehlkopfh **145** 82, 1938.

244 Shea, J. J. Infections of the Paranasal Sinuses of Dental Origin, Surg, Gynec & Obst **66** 408 (Feb. 15) 1938.

practice of maintaining the alveolar opening for drainage. He also points out the important fact that the dentist is relieved of a legal responsibility if after extraction of a tooth the antrum is accidentally perforated provided he immediately refers the patient to a competent rhinologist. 'The patient cannot successfully sue the dentist for penetrating the antrum but if the dentist continues to treat him he (the dentist) may be liable for not doing what 'the state of the art' demands.

Nyman²⁴⁵ writing from the dentist's point of view claims that in from 20 to 50 per cent of the cases antrum infection may be traced to a dental origin. Most of the antrum infections he has seen were due to "peridental infections the result of splinted teeth extensively involved with pyorrhea. He cautions against anchoring loose teeth affected with pyorrhea by means of ligatures or splints. Infection may also be carried into the antrum by means of broaches passed through the apex of a dead tooth when the root lies immediately below a thin antrum floor. Other causes of infection are forcing part of a molar root into the antrum or breaking the floor during extraction. Various measures for preventing these complications are outlined.

Lore²⁴⁶ covers a wide range of conditions in which the antrum and oral cavity are interrelated and offers some practical suggestions as to management. He does not believe an adequate flap can be made for the intranasal antrostomy. He suggests using the Faulkner bob and rasp and keeping the opening patent by frequent use of sounds.

Bercher and Guillermin²⁴⁷ report 2 cases of facial spasm due to dental and antral infection. The first patient a man of 53, had spasms of the orbicularis and of the angle of the mouth for six years. Extraction of diseased upper first and third molars was followed by increase of the spasms. The antrum was found to be diseased and was eventually operated on. The spasms gradually disappeared. In the second patient a woman of 45, there had been clonic and tonic facial spasms with nasal hydropnea for two years. Extraction of a diseased second molar was followed by prompt relief. The authors attribute the symptom to irritation of small branches of the sympathetic system which accompany the alveolar or pulp arteries.

Maxillary Sinusitis—Larroude²⁴⁸ presents a rather long dissertation on the pathologic changes, diagnosis and treatment of chronic maxillary

245 Nyman J. E. Associated Maxillary Sinus and Dental Diseases, *J. Am. Dent. A.* 25:600 (April) 1938.

246 Lore J. M. Diseases of the Maxillary Sinus and Their Relationship to the Oral Cavity. *Laryngoscope* 48:724 (Oct.) 1938.

247 Bercher J. and Guillermin. Spasme facial d'origine dentaire et sinusienne, *Rev. d'oto-neuro-opht.* 16:183 (March) 1938.

248 Larroude C. Les sinusites maxillaires chroniques. *Ann. d'oto-laryng.* February 1938 p. 113.

sinusitis with case histories and histologic sections. He attempts to divide the cases into operative and nonoperative, basing his indications on the state of the sinus mucosa as determined by studies with contrast mediums (colloidal thorium dioxide) and a determination of the emptying time according to Proetz's method. When ciliary activity has been determined to be fairly active and the sinus ostium free for drainage, if the roentgen studies show that simple hyperplasia exists, he believes the condition will yield to proper palliative treatment. He emphasizes several interesting anatomic and physiologic points, particularly those pertaining to the ostium. He calls attention to the fact that the ostium is not simply a hole but rather a canal leading from the fossa ovale into the sinus and confirms Fiol's observation that there is also a maxilloethmoid canal leading into a group of ethmoid cells. His review of the arterial, venous and lymphatic distribution is impressive since he adds certain experimental data showing the direction of circulatory currents carrying dye substances as indicating the usual course of bacteria and the defenses of the tissues.

Finder's ²⁴⁹ article is a simple and satisfactory review of the diagnosis and treatment of both acute and chronic conditions and is in conformity with the usually accepted practice.

Alspach ²⁵⁰ prefers puncture of the inferior meatus for irrigation if acute symptoms persist beyond five to seven days and advises leaving 5 to 6 cc of 1 per cent ephedrine in the sinus to help keep the ostium open. In subacute conditions he advises iodized oil by displacement if the usual irrigations fail to give relief.

Hall and Thomas ²⁵¹ record 12 cases of spontaneous hemorrhage from the antrum. The patients were from 31 to 66 years of age. Cases of traumatic hemorrhage were not included. Ten of the patients were operated on by the transcanine route, which revealed hyperplastic changes in the mucosa. No underlying systemic disease or vascular disorder was found. The source of the bleeding was revealed in only 3 cases. The diagnosis was made from a history of recurring spontaneous nasal bleeding, the presence of fresh bleeding coming from the middle meatus, burning pain at the inner canthus and a feeling as if the bleeding were coming from the eye. Burning and itching high up in the nose were also noted. Roentgenograms showed dark antrums, and lavage revealed fresh blood and clots. Two of the patients recovered following lavage. The author comments on the absence of any mention

249 Finder. Diagnose und Therapie der Kieferhöhlenentzündung, *Tung-Chi med Monatschr* **13** 173 (April) 1938.

250 Alspach, W. L. Diagnosis and Treatment of Maxillary Sinusitis, *J Oklahoma M A* **31** 43 (Feb) 1938.

251 Hall, S. S., and Thomas, H. V. Spontaneous Hemorrhage into the Maxillary Sinus, *Arch Otolaryng* **28** 371 (Sept) 1938.

of this condition in standard textbooks and has been able to locate only two references to it in the literature of the past ten years

Uryu²⁵² did a Caldwell-Luc operation on a child of 2½ years and found the antrum filled with cheesy masses, polypi and pus. There was a history of an acute swelling of the cheek six months previously, which was incised, with temporary recession of the symptoms. A fistula in the cheek persisted, which admitted a probe into the antrum. The anterior wall of the sinus was found to have been absorbed by the process. The etiologic factors were not known, although the author assumes it was spontaneous acute sinusitis.

Robbio Campos and Galante²⁵³ report a case of spontaneous abscess of the septum occurring shortly after acute maxillary sinusitis. They believe the infection was transmitted via the lymphatics or the blood stream.

Hersh²⁵⁴ reports a case of tuberculosis of the antrum in a woman of 27. The symptoms of pain and discharge led to a radical operation, which resulted in a persistent gingival fistula. A cold abscess in the loin yielded fluid which was proved to contain tubercle bacilli by culture and animal inoculation. The maxillary area remained swollen and tender, and roentgen pictures revealed bony involvement. The sinus was operated on again, and much necrotic bone granulations and pus were removed, which on examination confirmed the diagnosis. On account of the poor condition of the patient, extensive resection was not done, although the floor of the orbit was involved. The author reviews the literature and calls attention to the poor prognosis, recovery having occurred in only 6 of 26 reported cases. The diagnosis is difficult if the disease is limited to the mucosa. Later involvement of the bone and enlargement of the glands may suggest carcinoma, and the final diagnosis will depend on biopsy and animal inoculation.

Another case of tuberculous infection of the antrum is reported by Morihana and Yamamoto²⁵⁵. It began with a swelling of the cheek and pain and was diagnosed as acute sinusitis. The sinus was opened because the symptoms persisted and were followed by severe bleeding. Examination revealed a gingival fistula leading into a cavity filled with cauliflower masses which on histologic examination proved to be tuberculoma. The patient was operated on again and the cavity thoroughly

252 Uryu, E. Sinusitis maxillaris caseosa im Anschluss an akute Kieferhohlenentzündung bei einem Kinde, *Oto-rhino-laryng* **11** 425 (May) 1938.

253 Robbio Campos, J, and Galante, E. Absceso espontaneo del tabique nasal, *Rev. Asoc. méd. argent.* **52** 588 (June 30) 1938.

254 Hersh, J. H. Tuberculosis of the Maxillary Sinus, *Arch. Otolaryng.* **28** 987 (Dec) 1938.

255 Morihana, H. and Yamamoto, K. Ein seltener Fall von Tuberculoma in der Kieferhöhle, *Oto-rhino-laryng* **11** 341 (April) 1938.

cleaned out. In this case the diagnosis was easy because the patient had active pulmonary tuberculosis, and the Pirquet and Mantoux test were both positive.

An interesting case of foreign body within the antrum is reported by Hirayama²⁵⁶. A man of 38 while running a wood-cutting machine was struck in the cheek by a flying splinter, which he removed from the tissues himself. Three days later the cheek became swollen, and pain, tenderness and discharge appeared from the point of entry. Examination revealed a fistula at the upper end of the nasolabial fold which was lined with granulations, bled freely and admitted a probe to a depth of 5.5 cm. A Caldwell-Luc operation revealed a defect in the anterior wall of the sinus, covered partly by a fragment of bone, suppuration within the cavity and a small splinter of wood embedded in granulation tissue.

Disease of the Frontal Sinus—A number of cases of hyperostosis frontalis interna have been reported the last year. Van Steenberg-van der Noordaa²⁵⁷ cites 6 and presents roentgen pictures showing the thickened bone in characteristic locations. He feels that although the condition is not specific, its frequent occurrence in obese women associated with excess hair and other symptoms all point to a pituitary dystrophy as the etiologic factor. Rademaker²⁵⁸ encountered 5 cases, in all of which the patients were women. Psychosis, delusions, suicidal tendencies, catalepsy, mutism, headaches, weak memory and depression were among the symptoms listed. In 1 case the thickened frontal bone was surgically removed, with resulting improvement. The inner surface of the bone was covered by an irregular mass of new bone which was so adherent to the dura that the latter had to be removed with it. The arachnoid was generally thickened, the frontal convolutions flattened and the veins dilated. In 2 cases of this series the blood calcium was considerably elevated. Salzer²⁵⁹ reports 4 cases, the patients being women aged 26, 27, 38 and 40 and the symptoms those already mentioned. He believes the condition is due to a disturbance of the mechanism controlling fat metabolism and calcium. In 1 case improvement followed the administration of amino-acetic acid and thyroid. Negri²⁶⁰ observed the condition in a woman of 40, who presented the same dystrophic

256 Hirayama, S. Fremdkörper in der Kieferhöhle infolge Trauma, Otorhino-laryng **11** 219 (March) 1938.

257 van Steenberg-van der Noordaa, M. C. Six Cases of Hyperostosis Frontalis Interna, Nederl tijdschr v geneesk **82** 3751 (July 30) 1938.

258 Rademaker, G. G. J. Internal Frontal Hyperostosis (Morgagni Syndrome), Nederl tijdschr v geneesk **82** 2245 (May 7) 1938.

259 Salzer, H. M. The Frontal Hyperostosis Syndrome, J. Med **19** 507 (Dec.) 1938.

260 Negri, C. Associazione di alterazioni endocraniche e adipose (endocraniosi iperostotica del Morgagni), Minerva med **2** 109 (Aug. 4) 1938.

symptoms together with psychic disturbances. In this patient the metabolic rate was normal as was the blood calcium.

Lopez Villoria ²⁶¹ presents in detail 3 cases of syphilis of the frontal bone. He states that the sinuses may be involved by syphilis in four different ways: (1) secondary to ulceration within the nasal cavity, (2) secondary to syphilitic osteitis of the septum or ethmoid bone, (3) congenitally and (4) primarily through the blood stream. He claims that the process usually remains localized, showing no tendency to spread through the diploetic skull bones. The diagnosis is frequently difficult, for the Wassermann test may be negative and the condition may appear like ordinary chronic sinusitis or tuberculosis.

Meksina and Khayutin ²⁶² report 2 cases of syphilis: the first involving the ethmoid sinus and the antrum and the second the frontal sinus. In the first case there was a history of trauma to the root of the nose one week prior to the appearance of a swelling at the inner canthus and adjacent nasal bone. A solid mass the size of a nut was felt in the lacrimal region, immobile and not tender. A roentgenogram revealed a cloudy antrum and an ethmoid labyrinth with thickened bone. Puncture of the antrum gave negative results. The Wassermann, Kahn and Meinicke reactions were all positive. In the second case there was also a history of trauma preceding the swelling by one week. A smooth, firm mass was found just above the brow and a roentgenogram revealed definite involvement of the bone. The serologic tests were all positive.

Ethmoid-Sphenoid Disease—Kawasaki ²⁶³ did an intranasal ethmoidectomy on a woman of 39 and found the cells almost entirely obliterated by a mass of thick cheesy material. The process was found to involve the sphenoid sinus as well, and there was extensive absorption of the middle turbinate lamina papyracea, uncinate bone and attachment of the inferior turbinate. The nasal cavity proper was blocked by polypoid masses, which evidently had interfered with drainage.

Ipolyi ²⁶⁴ reports an orbital abscess in a boy of 16 following an acute infection of the upper respiratory tract. Since the antrum was also infected and the septum deviated so as to block the middle meatus, he did a submucous resection, drained the antrum and attempted to open the ethmoid labyrinth. This he found to be extremely difficult because of the unusual density of the bony partitions. He explains this ivory-

261 Lopez Villoria, L. Sífilis del frontal, *Gac. méd. de Caracas* **44**:179 (June 30) 1937.

262 Meksina, F. M., and Khayutin, I. M. Traumatic Syphilis of the Nasal Sinuses and Lacrimal Sac. *Zhur. ush. nos i gorl. bolez.* **15**:169, 1938.

263 Kawasaki, T. Ein Fall von der käsigen Entzündung der Siebbeinzellen und Keilbeinhöhle. *Taiwan Igakkai Zasshi* **36**:2630 (Dec.) 1937.

264 Ipolyi, F. Akute Entzündung eines infolge kongenitaler Lues eburneierten Siebbeins. *Monatsschr. f. Ohrenh.* **72**:937 (Oct.) 1938.

like bone, as well as the absence of the frontal sinus as being the result of ethmoiditis eburnea syphilitica hereditaria. The Wassermann reaction was positive.

In a study of 137 postmortem specimens Eadie²⁶⁵ found extension of the sphenoid sinus into the pterygoid process dorsolaterally and caudally on the right side in 47 and on the left in 44. Also in 52 cases (35 per cent) there were evidences of inflammation. Further investigation of a series of 89 patients by the Watson-Williams exploration suction method yielded positive cultures from 53. In most of these patients there were clinical signs of nasopharyngeal infection. The author states, however, that this method of diagnosis (by culture of aspirated fluid) is of value only when the cultures are positive, and this applies to cases in which the antrum is involved as well.

Canfield²⁶⁶ presents 3 cases of sphenoiditis, with the symptoms, diagnostic procedures and therapy. In case 1 there was persisting supra-orbital, infraorbital, facial, aural and occipital pains, central scotoma and contraction of the visual fields. The septum was resected, the sphenoid ostium enlarged and the sinus relieved of some thick pus. The pain subsided. In case 2 the patient had head pains, a heavy feeling behind the eyes and nasal crusting. Irrigation of both sphenoid sinuses afforded relief. After roentgen studies with iodized oil the sphenoid openings were enlarged, and permanent relief resulted. In case 3 there were periodic throbbing headaches and postnasal discharge. One sphenoid sinus was found to be full of a cheesy exudate. Relief was afforded by the operation, but the pains returned when the opening closed. The author emphasizes the importance of roentgen studies with iodized oil and the necessity of obtaining a good view of the ostium of the sphenoid sinus in making a diagnosis.

Caldwell²⁶⁷ presents a discussion of the diagnosis of sphenoiditis embracing the commonly accepted procedures. He advises the use of Sluder's knives for entering the sphenoid sinus and states that the middle turbinate must be removed in about 50 per cent of the cases.

Kraus's²⁶⁸ paper is a rather sketchy review of the literature covering tumors of the epipharynx affecting the base of the sphenoid sinus, tumors of the sphenoid sinus and tumors of the hypophysis. Nothing new is offered.

265 Eadie, C. M. Posterior Nasal Sinusitis, *M. J. Australia* **1** 487 (March 12) 1938.

266 Canfield, N. The Clinical Recognition and Treatment of Chronic Sphenoiditis, *Kentucky M. J.* **36** 284 (July) 1938.

267 Caldwell, R. Sphenoid Sinusitis, *J. Arkansas M. Soc.* **34** 163 (Jan) 1938.

268 Kraus, L. Ueber Erkrankungen im Keilbeinkörper und seiner Umgebung, Hals-, Nasen- u. Ohrenarzt (Teil 2) **46** 1 (Jan) 1938.

Disease of the Sinuses and Allergy—Faulkner's ²⁶⁹ presentation deals with the practical evaluation of pathologic factors found in conjunction with allergic manifestations. In general he favors giving the case over to the allergist when gross pathologic alteration is not readily demonstrated or when the symptoms are predominantly allergic. However, one must not rely entirely on attempts at desensitization since in many cases the disease will fail to yield until attention is paid to relieving pressure from local hypertrophies. The discovery of polypi should always lead to a thorough study of the sinuses. The cytologic examination is of value here in deciding for or against surgical treatment. The author recalls many cases in which the polypi appeared to be entirely on an allergic basis yet the history of a previous acute infection and the predominance of symptoms on one side pointed to infection, and subsequent operation justified the diagnosis. He calls attention to headaches of the 'morning after' type which are due to hyperplasia within the ethmoid cells and sphenoid sinus without extrusion of polypi into the meatuses. Properly interpreted roentgen pictures should demonstrate this condition clearly.

Kern and Schenck ²⁷⁰ are definitely of the opinion that polypi are in every instance an evidence of an allergic basis and make the statement that "avoidance of, or desensitization with allergens yields clinical results far superior to the old routine of surgical removal alone with its distressingly frequent recurrence of the polyps." They advise against any surgical treatment during the pollinating season and advise removal of polyps only when they are obstructive. Their entire emphasis is on the allergic side of the question minimizing the question of coincident infection and the necessity for surgical intervention.

Ophem ²⁷¹ makes a thorough analysis of a large number of cases on the basis of symptoms, operative findings, histologic sections and phenomena of allergy and concludes that 25 per cent of all cases may be included under the designation of "rhinosinusitis chronica hyperplastica allergica." These cases are characterized by catarrhal symptoms, nasal obstruction, frequent colds. Roentgen studies and cytologic examination are important in diagnosis. The author advises surgical operation only for major anatomic defects and states that he has had good results from the use of nonspecific desensitization recommending "novoprotin" (a plant albumin) as a particularly useful agent.

269 Faulkner, E. R. Problems in Diagnosis and Treatment of Hyperplastic Sinusitis and Allergy. *Ann Otol Rhin & Laryng* **47**:141 (March) 1938.

270 Kern, R. A. and Schenck, H. P. The Diagnosis and Treatment of Mucous Nasal Polyps with a Consideration of the Allergic Factor, *M. Clin North America* **22**:1633 (Nov.) 1938.

271 Ophem, O. F. Allergic Diseases of Nose and Sinuses, *Nord med tidsskr* **16**:1607 (Oct. 15) 1938.

Black²⁷² reports in detail a case which illustrates the difficulties of differentiating between chronic sinusitis and perennial hay fever. Despite positive roentgen evidence of thickened mucosa, more reliance is placed on the pale mucosa, the watery discharge and the increase in eosinophils. If in addition there are positive skin reactions, there can be no doubt of the predominant role of allergy in the case, and surgical treatment should be restricted to removal of gross obstructions. The author suggests the oral administration of ephedrine or benzedrine in preference to their local application.

Fractures—Fehr²⁷³ made a study of 417 patients with basal skull fractures treated at the Zurich Clinic during the past seventeen years. In 20 (4.8 per cent) meningitis developed from fractures in the vicinity of the sinuses. In 18 of these the meningitis appeared early and in 16 ended fatally on an average of seven days after the accident. The statistics show that meningitis is three times as frequent with fractures involving the sinuses as with fractures affecting the petrous bone. The course is usually stormy, leading to early death, especially if the cribriform plate or the ethmoid labyrinth is involved. The author advises against routine operations on skull fractures involving the sinuses because experience shows that most of the patients get well. If, however, symptoms of meningitis appear there should be no delay in widely exploring the sinus area in contact with the brain.

Laskiewicz²⁷⁴ presents an extensive discussion of fractures and foreign bodies of the sinuses and reports 10 cases. The treatment depends on the nature and extent of the involvement. Simple fractures involving the walls of a sinus may be treated conservatively. In the presence of complications, such as displacement of fragments, hemorrhage or injury to the dura, the indication is to do an external operation. It is important to distinguish between a simple fracture and one complicated by an infection. Conservative treatment is directed toward the prevention of the latter. At the same time the author advises operation when there is displacement of a fragment of bone from the anterior or posterior wall of the frontal bone, the anterior wall of the antrum or the ethmoid bone. The exposure should be wide enough to permit adequate inspection of the affected area, so that foreign bodies and bone fragments may be removed and open drainage instituted. Seven cases of foreign body are reported as follows: (1) A portion of a bullet

272 Black, J. H. Perennial Hayfever Diagnosed as Chronic Sinusitis, *Internat Clin* **1** 266 (March) 1938.

273 Fehr, A. Zur Behandlung von Schadelbasisbrüchen bei Komplikationen von Seiten der Nasennebenhöhlen und des Ohres, *Helvet med acta* **19** 637 (Nov) 1937.

274 Laskiewicz, A. Considerations sur le traumatisme des sinus et leurs corps étrangers, *Rev de laryng* **58** 937 (Nov) 1937.

was extracted from the ethmoid sinus through an external operation, (2) a bullet and fragments of bone were removed from an antium by way of a Caldwell-Luc opening, (3) a gutta percha plug that had been forced into the antium from an alveolar fistula was removed through a Caldwell-Luc opening, (4), a fragment of shrapnel was removed from the antium by a Caldwell-Luc opening, (5) a shell fragment was observed in the antium, but operation was refused, (6) the root of the first molar was in the antium and was removed through a canine fossa approach, (7) a rhinolith of the inferior meatus was eroding into the antium

Killian²⁷⁵ reports a case of depressed fracture of the frontal sinus in a man of 25, with extension into the base. The patient was brought to the clinic four weeks later with impaired vision, tender frontal area and depressed nasal bridge. Roentgen findings indicated a fracture through the frontal bone extending into the orbit and an accumulation of air posterior to the frontal bone. In addition rhinorrhea was noted. At operation a depressed fragment was removed, and the entire frontal bone was found pushed backward, its posterior wall splintered and the dura torn. Light adhesions were already present. The cavity was packed and left open. Later roentgen examination showed the pneumatocele increasing in size. The rhinorrhea was also continuous, and a new symptom appeared, namely, paresis of the superior oblique ocular muscle. The fundus was normal. A second operation was performed to close the fistula. Eventually the rhinorrhea ceased, the air disappeared, and the fractures healed. Analysis of 110 cases from the literature shows that 37 of the patients recovered under conservative treatment and 37 after operation, while 8 died under conservative treatment and 20 after surgical intervention. Examination of the fatal cases reveals the following complications: pneumatocele from gunshot wounds in 17 per cent, pneumatocele from gas bacillus in 50 per cent, pneumatocele from frontal fracture in 22 per cent, pneumatocele from basal fracture in 30 per cent, and pneumatocele from tumors in 33 per cent. The high percentage of recoveries under conservative treatment proves the value of waiting. This also accounts for the higher mortality among the patients operated on, since surgical operation was resorted to only when complications arose. Of 59 patients with traumatic pneumatocele, 46 recovered. Eight of the 10 deaths in this group followed surgical intervention. On the other hand, 10 patients who were operated on to relieve pressure on the brain all recovered.

²⁷⁵ Killian, H. Pneumatocele des Stirnhirns nach Trauma, *Zentralbl. f. Chir.* 65 1186 (May 21) 1938

Fenster's ²⁷⁶ case was that of a man of 33 who fell 85 meters on his head, sustaining a fracture which rendered him unconscious. Roentgen examination showed a linear fracture of the right frontal bone into the orbit and air in the left lateral ventricle and the third ventricle. Later pictures showed air in the posterior horn of the lateral ventricle, the subarachnoid space and the fossa rhomboidea. Also the fracture line was seen to extend through the lamina papyracea. The author assumes that the air entered the fracture line in the ethmoid region, passed to the cranial base, from here over the subarachnoid space and because of the prolonged low position of the head finally entered the foramen magnum and extended thence to the ventricular system. He believes that the low position of the head definitely predisposes the patient to the entrance of air within the cranial cavity in cases of this type.

Miscellaneous Studies—Cullom ²⁷⁷ believes that sinus infection is a frequent cause of suppurative otitis media and favors surgical treatment of the focus. Should the sinusitis exist in the presence of mastoiditis, he advises operating on the mastoid first and taking care of the sinus as soon after as feasible. According to the author, purulent otitis media and mastoiditis are the result of suppuration from a sinus in at least 85 per cent of the cases. A number of instances are cited in illustration.

Mazza and Olle ²⁷⁸ contribute a paper which was part of a symposium on trypanosomiasis following an epidemic of the disease in the Argentine Republic. They report 5 cases in which this disease simulated acute sinusitis, most of the patients were children. They showed rapid onset of illness, with edema of the face, lids and forehead, leading to a mistaken diagnosis of acute frontal or ethmoid sinusitis. A correct diagnosis was made on recovery of the parasites from the blood stream and finding of the typical blood picture, viz., decrease in polymorphonuclears and increase in lymphocytes, monocytes and eosinophils. In addition the following symptoms were present: rapid pulse, enlargement of the spleen and lymphatic glands.

Bouchet and Bourdial ²⁷⁹ attempt to define a new clinical entity in which serous rhinorrhea is associated with a definite pathologic condition of one or more sinuses. The condition is due either to a renal disturbance or to colloidoclastic shocks producing vasomotor crises at

²⁷⁶ Fenster, E. Stirnbeinfraktur mit Luftansammlung im Schadelinnern, Röntgenpraxis **10** 101 (Feb.) 1938.

²⁷⁷ Cullom, M. M. Chronic Middle Ear and Mastoid Infection, J. Tennessee M. A. **31** 11 (Jan.) 1938.

²⁷⁸ Mazza, S., and Olle, R. Observaciones de formas agudas benignas de enfermedad de Chagas, una de ellas considerada sinusitis frontal, en Santiago del Estero, Invest. enferm. de Chagas, 1938, no. 39, p. 22.

²⁷⁹ Bouchet, M., and Bourdial. Les sinusites serouses, Paris med. **2** 158 (Sept. 3) 1938.

intervals. He believes that the disease of the mucosa of the sinuses is the inciting cause. Symptomatically it is characterized by crises of severe coryza with profuse watery discharge and evidence of unilateral sinus involvement. Roentgen examination with use of iodized oil will usually demonstrate the seat of the pathologic changes. Puncture and aspiration reveal a flocculent, fibrinous, shreddy discharge. The clinical investigation should determine whether the sinusitis is the primary cause or whether it is secondary to the constitutional condition which the author terms the *colloido-clasique diathèse*, exudative or allergic. As for therapy, if the patient is definitely allergic, the treatment must be conservative. Otherwise the author advises puncture and lavage and, if necessary, a nasointial window operation. He has found a careful dietary regimen of value for both types of patient.

Schutz²⁸⁰ reports 8 cases of malignant granuloma of the nose and sinuses observed in the Charité clinic over a period of years. Six of the patients died. One is still living but not cured. One is definitely cured. In most of the cases the disease lasted from three to twenty-four months. In the patient who recovered spontaneously an ulceration of the lateral nasal wall, middle turbinate and septum had already developed. In all the other cases roentgen rays, radium, surgical and other measures were tried without result. Autopsies in 4 cases failed to help in the diagnosis. Bacterial studies were inconclusive and animal inoculations without result. Histologic studies showed marked granulation tissue, infiltration with round cells and here and there large pale round cells, occasional mitosis and typical vascular reaction. The difficulty in diagnosis arises from inability to say whether the round cells are of inflammatory origin or true tumor cells, and this is what makes the only diagnosis possible, namely, "granuloma malignum." A zone of necrosis is also frequently found on which the author comments as follows: "Without apparent cause a progressive breaking down of cellular structure takes place with very little exudation from the blood vessels; nothing in the granulation tissue speaks for a change by which the necrosis could be termed primary." The blood usually showed slight leukopenia, which helps differentiate the condition from lymphosarcoma. Also there is a shift to the left with large numbers of band cells. The picture is similar to that of typhus or paratyphus. At the height of these diseases lymphocytosis appears in those cases in which improvement is shown. Such a change was observed in a case of morbus Bang in which there was a beginning malignant granuloma of the antium which healed. This similarity suggests the possibility of an infectious origin of the disease.

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280 Schutz, W. Verschiedene Formen von Gangran der Nase und Nasennebenhöhlen, Ztschr. f. Hals-, Nasen- u. Ohrenh. 44: 244, 1938.

Abstracts from Current Literature

Ear

PATHOLOGY OF MENIERE'S SYNDROME C E HALLPIKE and H CAIRNS, *J Laryng & Otol* 53 625 (Oct) 1938

Hallpike and Cairns describe the microscopic changes in the temporal bones of 2 patients with Meniere's syndrome. In each of these the affected temporal bone showed gross distention of the endolymphatic system, together with degenerative changes in the sensory elements. A possible explanation of this distention is suggested by the absence in both patients of the normal area of connective tissue around the saccus endolymphaticus.

J A M A

THE INDICATIONS FOR OPERATION IN MASTOIDITIS MAX BERGER, *Rev de laryng* 59 418 (May), 582 (June), 656 (July-Aug), 779 (Sept-Oct), 867 (Nov) 1938

This is actually a monograph of one hundred and sixty pages published serially in five succeeding issues of the *Revue*. There is a bibliography of forty-three pages, which begins with the year 1880 and carries one reference for 1938. There are eighteen line diagrams. The author considers normal anatomy, pathologic anatomy, clinical (including roentgen) findings and operative findings. The work is divided into five sections as follows: anatomy, pathologic anatomy, clinical types, indications for operation and conclusions. The monograph is based on the cases studied in Potmann's clinic and already summarized in the thesis of Chérishamade. Five hundred and eighty-six cases were analyzed. The discussion of anatomy is on the whole satisfactory, although it tends to be more architectural than developmental. Particularly glaring is the omission of the work of Körner on the developmental cell tracts in the temporal bone. This is especially surprising considering the prominence that the author gives to the petrosquamosal suture and the accurate depiction of its relation in the diagrams. (The reviewer differs with the author's account of the differences between the infant and the adult position of the mastoid antrum.) The author, however, does not revert to the early description, which is still common in many accounts. The discussion of pathologic anatomy follows fairly classic lines. Here again the description of the extension to the various parts of the temporal bone and into the surrounding tissues follows a more or less architectural pattern, and the author does not consider the anatomic tissues involved. Little or no mention is made of the role of the venous system in the propagation of infection into the various parts of the temporal bone and into the surrounding tissue. The author observes that eburnated bone alone resists infection and that, whether the bone is pneumatic or diploetic, infection will spread through it under proper circumstances. He declares himself against the concept of primary mastoiditis and prefers to call the condition in the cases pseudoprimary, feeling that careful questioning of the patient and a careful clinical examination will develop the essential character of a disease spreading from the middle ear or secondary to some systemic infection. As to the invading organism, the author seems to feel that *Streptococcus* or *Streptococcus mucosus* is the common infecting organism and that no further thought need be spent on this subject. (While in few American clinics culture of the material obtained by paracentesis is made as a routine, there seems to be a general feeling that the practice of otology would be definitely improved by this procedure.) Particular attention is paid to mastoiditis in the aged; the author states that the heavier bone in the aged is a confusing finding and leads to the overlooking in many cases of mastoiditis in the early stages. The discussion of the clinical diagnosis minimizes the importance of the roentgen findings. The author feels that they are so variable that but little

dependence can be placed on them (This again is rather contrary to the accepted American opinion that the roentgen findings, while not sufficient to furnish indication for operation, should always be considered in determining on opening the mastoid process) Three procedures practically unheard of in America are discussed as useful in diagnosis One is the percussion technic of Masini Percussion of a diseased mastoid process gives a dull note in comparison to the normal sound This is more apparent to the patient than to the examining physician In the auscultation procedure of Miodonski two Toynbee diagnostic tubes are used With a low-pitched tuning fork, similar areas are compared on the two sides of the head The transmission by bone conduction is much accentuated on the diseased side, and the statement is made that by careful work it is almost possible to limit exactly the extent of the disease The third unusual procedure is the caloric procedure of Zalewski, which has one or two modifications In its primary form, the mastoid areas are cooled with Leiter coils, and the rate in the drop of temperature in the external auditory canal is noted The fall in temperature is less on the diseased side In concluding, the author speaks strongly in favor of surgical intervention to prevent complications and decries indecision when both the clinical signs and the prognosis are grave

BATSON, Philadelphia

BONE CONDUCTION G G KOULIKOVSKY, *Rev de laryng* **59** 521 (June) 1938

These studies, from Prof V I Voyatchek's laboratory in Leningrad, Russia, are reported in considerable detail Bone conduction was studied in living animals and human beings and on the dry skull A sound-proof room and the necessary modern electrical equipment were available The animal was studied by the method of Wever and Bray The dried skull was investigated by the usual method of using a "driver" attached directly to the skull and a "pick-up" which could be moved In the human being, microphones placed over the auricle picked up the vibrations produced by a tuning fork held against the head Investigators will no doubt familiarize themselves with this work in the original article The conclusion that under controlled conditions in a sound-proof room there is no evidence of prolonged bone conduction is of general interest

BATSON, Philadelphia

ZYGOMATIC MASTOIDITIS PIQUET and DEROSNE, *Rev de laryng* **59** 817 (Nov) 1938

The authors report observations in 17 cases Zygomatic mastoiditis is characterized essentially by a tendency to exteriorization in the temporal fossae Edema of the soft tissues is marked, and the abscesses frequently are large The localization corresponds to the supra-antral extension of the mastoid cells Anatomically, there is always excessive development of the pneumatic cells in this area Almost always there is a deep temporal abscess between the muscle and the bone With the pneumococcus or the streptococcus as the infecting agent, there may be no abscess but only edema Zygomatic mastoiditis is particularly common in the young infant, although it occurs also in the adult Ordinarily it is seen as a primary clinical state, following shortly after suppuration of the middle ear The clinical findings are signs of localization at the surface The elevation of temperature is insignificant, and there is little disturbance of the general health The development is rapid Trismus is exceptional The abscess may localize in the mastoid area The authors feel that surgical intervention must be carried out early Extensive mastoidectomy must be performed

BATSON, Philadelphia

OTOGENOUS ENCEPHALITIS PURULENTA PROGRESSIVA HANS BRUNER and ROBERT DINOLT, *Ztschr f d ges Neurol u Psychiat* **162** 106 (March) 1938

Bruner and Dinolt report 2 cases of diffuse hemorrhagic purulent encephalitis following infection of the ear The patients were men aged 44 and 34 In

both cases the disease followed an acute exacerbation of chronic otitis media. In the first case there was extension of the infection from a thrombosed sinus to the occipital lobe, and in the other, direct extension from the infected ear along the pial vessels into the contiguous temporal lobe. In neither case was an abscess observed at necropsy, though in the first case the duration of the illness was ten and in the second twenty-three days. Focal signs of involvement were present. In both instances a clinical diagnosis of abscess of the brain was made, though exploration gave negative results. The authors suggest the term otogenous encephalitis phlegmonosa for this condition, especially because of the rapid spread of the purulent infection. Microscopic examination showed considerable polymorphonuclear infiltration but no abscess formation which could be treated surgically.

SAVITSKY, New York [ARCH NEUROL & PSYCHIAT]

THE REPORT OF A STUDY OF OCCUPATIONAL DEAFNESS. STERNBERG, *Ztschr f Hals-, Nasen- u Ohrenh* 44 310, 1938

The author has made a study of occupational deafness in persons with a number of occupations, such as metal workers and operators of air pressure hammers. While these patients were blaming their occupation for their increase in deafness, the author's study failed to establish this factor as a direct cause. However, he believes that when deafness or some underlying constitutional disease exists, the occupation may act as a secondary factor.

PERSKY, Philadelphia

SEQUESTERING PERIOSTITIS AS A CAUSE OF CHOLESTEATOMA OF THE EXTERNAL AUDITORY CANAL. OTTO MAYER, *Ztschr f Hals-, Nasen- u Ohrenh* 44 337, 1938

The author cites 4 cases of cholesteatoma of the external canal. The tympanic membrane was intact in each case. He believes that the causative factor was periostritis of the canal and does not believe that the condition was purely an evidence of an epidermal plug. With an epidermal plug, he believes, there is usually a disproportion between the rate of formation of the epidermal tissue, its desquamation and its expulsion from the canal. This is not shown by the microscopic study in his cases. He suggests that there may be a syphilitic basis for the cholesteatoma.

PERSKY, Philadelphia

THE CLINICAL CONSIDERATION OF CHOLESTEATOMA OF THE MIDDLE EAR AND ITS COMPLICATIONS. HELMUTH RICHTER, *Ztschr f Hals-, Nasen- u Ohrenh* 44 340, 1938

The author reports a series of 136 cases of cholesteatoma of the middle ear in patients varying in age from 1 year to 68, three quarters of them belonging in the first three decades.

In 13 cases the cholesteatoma was bilateral. The author performed 143 operations in all, 87 on the right ear and 56 on the left, but he did not attach any particular significance to the incidence on either side. Eighty-one patients were studied roentgenologically, of these, 80 showed marked limitation of pneumatization. He had 123 recoveries and 14 deaths (10 per cent).

He had an impressive series of complications (110 cases): subperiosteal abscess in 9 cases, extradural abscess in 11, perisinus abscess in 25, labyrinthitis in 27, thrombosis of the lateral sinus in 13, cerebral abscess in 4, abscess of the temporal lobe in 4 and suppurative meningitis in 17. Those in 65 were dangerous. Analysis of 62 of these 65 cases showed 48 recoveries (77 per cent) and 14 deaths (23 per cent). The organism most frequently found was *Bacillus proteus* (37 cases), next in frequency were the hemolytic streptococcus, *Staphylococcus aureus* and *Staphylococcus albus*, the other usual organisms were less frequent. The spinal fluid, studied in 13 cases of meningitis, was sterile in 4.

In summarizing, the author discusses the question of 14 deaths and stresses both the importance and the danger of cholesteatoma as indicated by this long list of complications. He finally urges that an early operation be undertaken whenever cholesteatoma is suspected.

PLRSKY, Philadelphia

Pharynx

PROGNOSIS IN CASES OF TUBERCULOSIS OF THE TONSILS, ADENOIDS AND CERVICAL LYMPH NODES. A STUDY OF PATIENTS FOLLOWED FOR ELEVEN TO TWENTY-THREE YEARS. J. BORDLEY III and J. W. BAYLOR, Bull. Johns Hopkins Hosp. **63** 132 (Sept) 1938.

Seventy-nine patients who at operation between 1912 and 1924 were discovered to have tuberculosis of the tonsils or adenoids were subjected to reinvestigation in 1935. Of 47 patients operated on prior to the age of 14, 45 could be traced, 2 of these had died of nontuberculous diseases, and 1, of tuberculous meningitis several months after operation. All the 42 living patients were well. The 2 patients who could not be traced were well when last seen, from fifteen to twenty-two months after operation. In this group the incidence of serious tuberculous sequelae was low, and no patient showed any evidence of having acquired pulmonary tuberculosis of the adult type since the operation. The high incidence of tuberculous cervical adenitis and the complete absence of progressive pulmonary tuberculosis among these patients constitute an interesting observation in view of the controversy concerning the prognosis of this form of tuberculosis.

LYTTLE, New York [AM J DIS CHILD]

CERVICAL ADENOPATHY DISCLOSED A PHARYNGEAL EPITHELIOMA IN A BOY OF NINE YEARS. M. CONDAT, J. GADRAT and J. LASSERRE, Arch. de med. d. enf. **41** 563 (Sept) 1938.

Neoplastic adenopathies, frequent enough in adults, are extremely rare in children. The writers report a case of voluminous cervical adenopathy which for several months was the sole manifestation of latent epithelioma of the pharynx. Cervical adenitis followed an attack of measles, the origin was at first considered tuberculous, and the boy was subjected to radiotherapy, without visible improvement. When he entered the hospital a painless mass was noted occupying the entire lateral aspect of the right cervical region, the skin was not adherent. On the left side three small nodules were present along the course of the jugular vein, but no further ganglionic area was involved. Examination of the posterior pharyngeal wall revealed a tumefaction, particularly noticeable toward the right. Histologic investigation following removal of one of the small glands of the left cervical region and of tissue from the pharyngeal tumor showed identical evidence of a basocellular epithelioma, springing primarily from the mucosa of the pharynx.

The evolution of the neoplasm was rapid, the boy became dyspneic, and a fatal hemorrhage terminated life seven months after the cervical adenopathy was first noted.

AMESSE, Denver [AM J DIS CHILD]

FATAL SPONTANEOUS HEMORRHAGE FROM A TONSIL. E. SCHLITTLER, Pract. oto-rhino-laryng. **2** 19 (Feb) 1939.

The author reports a case of spontaneous hemorrhage from one tonsil, apparently due to erosion by phlegmonous necrotic inflammation.

The patient, in spite of this condition, did not show any evidence of generalized infection or toxemia. Microscopic examination of the tonsillar bed showed extreme alteration of the smaller blood vessels within the necrotic area, but the author was not able to see any evidence of erosion of the larger arteries or veins.

PERSKY, Philadelphia

Nose

RHINOSPORIDIOSIS IN UNITED STATES G T CALDWELL and J D ROBERTS,
J A M A **110** 1641 (May 14) 1938

Caldwell and Roberts report the case of a white boy aged 16 who complained of nosebleed for three months. A small polypoid mass attached to the right side of the nasal septum had first been noticed two months previously. Histologic study of the lesion revealed edematous vascular fibrous tissue in which were scattered many spherical encapsulated cystlike structures varying in diameter from 40 to 300 microns. These were considered to represent various stages in the development of *Rhinosporidium seberi*. Only 6 previous cases in the United States have been reported. LIWIS, New York [ARCH DERMAT & SYPH]

PARANASAL SINUS DISEASE IN CHILDREN S Z FAHR, Nebraska M J **23** 370
(Oct) 1938

It is reasonable to suppose that diseases of the nasal sinuses are not rare in children, though they are often overlooked. Such factors as deficiencies in the diet, allergy and other abnormal conditions, such as local obstructions, are worthy of attention. The ethmoidal cells are always present at birth, and the maxillary sinuses are only rarely absent. The presence of swollen membranes about the ostium of a sinus, foreign bodies, tumors or anything else that causes stagnation always results in infection. Roentgen examination should be made early rather than late. If there is malnutrition, chronic arthritis, chronic bronchitis, bronchiectasis or other systemic infection, tonsillectomy and adenoidectomy often improve the child's general condition. Listlessness, poor appetite, underweight and anemia suggest the possibility of chronic sinusal infection. In acute involvement of the sinuses the predominant symptoms are nasal stoppage or a feeling of fullness in the head with nasal discharge, pain and headache may be brought about by closed empyema. In older children a small mirror can be used for postnasal examination. Smears may reveal either a large number of pus cells or a predominance of eosinophils, indicating allergy. Swelling of the eyelids and cheeks, tenderness of the involved sinus and enlargement of the postcervical glands are often present. Cooperation between the otolaryngologist and the pediatrician is necessary. In a great percentage of the cases of sinusal infection operation for the removal of obstructions is sufficient. The aim of treatment is to obtain ventilation and drainage by the simplest method possible. In a large percentage of cases chronic sinusal infection in a child clears with removal of the tonsils and adenoids.

HAMILTON, Omaha [AM J DIS CHILD]

VARIOUS TYPES OF GANGRENE OF THE NOSE AND NASAL SINUSES WALTER
SCHUTZ, Ztschr f Hals-, Nasen- u Ohrenh **44** 244, 1938

The author cites 8 cases of malignant granuloma of the nose and sinuses. There were 6 deaths and 2 recoveries. Two of the patients who died had complicating lymphosarcoma with terminal metastasis. The other 4 died of meningeal complications.

He discusses the various types of granuloma in his series, establishing a diagnosis by both biopsy and examinations of the blood. While the pathologic changes had been localized in a few cases to the nose and sinuses, they were often part and parcel of the generalized infective process.

PERSKY, Philadelphia

SINUSITIS AS A CAUSE OF DISEASE OF THE UVEAL TRACT JOSEF JASCHEK, Ztschr
f Hals-, Nasen- u Ohrenh **44** 264, 1938

The author cites 4 cases of ocular complications relieved by surgical treatment of a sinus. The complication occurred in 3 cases on the same side as the affected

sinus There were 3 Caldwell-Luc operations, 1 with ethmoidectomy, and 1 ethmoidectomy alone

The author states that it was difficult to establish the relation between the pathologic changes of the eye and those of sinuses, while there may be an anatomic relation between the two structures, he is of the opinion that there may have been an infection with a virus that is specific for the uveal tract. He stresses the role of focal infection in the case of contralateral involvement.

PERSKY, Philadelphia

CEREBROSPINAL RHINORRHEA WESSLEY, *Ztschr f Hals-, Nasen- u Ohrenh* **44** 268, 1938

The author cites a case of cerebrospinal rhinorrhea which followed a severe sinusal infection—post scarlatinal—and lasted six years, finally terminating fatally.

A large defect in the lamina cribrosa on one side, with prolapse of the brain through this defect, was observed post mortem.

He believes that while cerebrospinal rhinorrhea in itself is not acutely dangerous, in that the patient may survive for some time, it always terminates in meningitis. The danger of a fatal termination is always accentuated by the presence of acute infection of the upper part of the respiratory tract.

PERSKY, Philadelphia

Miscellaneous

LUNG ABSCESS AND ITS RELATION TO SURGERY OF THE UPPER RESPIRATORY TRACT
H. MORRISON, *New England J Med* **218** 669 (April 21) 1938

The otolaryngologist rarely, if ever, sees pulmonary abscess as a complication of operative conditions. Studies of large series of cases of tonsillectomy show pulmonary abscess occurring on the average once in 2,000 or 3,000 cases.

In 1925 F. T. Lord reported 227 pulmonary abscesses observed at the Massachusetts General Hospital between 1909 and 1924. Of these, 96 (42 per cent) followed operative procedures, 78 (34 per cent) followed operations on the upper part of the respiratory tract, of which 21 (9 per cent) occurred after the extraction of teeth, 49 (22 per cent) after tonsillectomy and the remaining 8 after operations elsewhere. Aspiration of foreign bodies was responsible for 8 abscesses. In this series 28 (12 per cent) of the abscesses were ascribed to pneumonia. One followed esophagoscopy examination. The cause of the rest was not determined.

From the point of view of the prevention of abscess of the lung, several propositions stand out. Tonsillectomy and other operations on the nose and throat are major surgical procedures. They should be performed in a hospital, and the patients should be carefully followed. Local anesthesia is preferable to general, but more important than the type of anesthesia is the qualification of the anesthesiologist. It is well established that the danger of pulmonary abscess after tonsillectomy is much greater in adults than it is in children.

Extractions of teeth should be done in several sessions, obviating general anesthesia and too large a wound and minimizing the danger of aspiration of a foreign body.

GENGENBACK, Denver [*Am J Dis Child*]

ANATOMIC INTRACRANIAL LESIONS IN RETROBULBAR NEURITIS G. SOURDILLE, *Arch d'opht* **1** 3 (Jan) 1937

After reporting 25 cases of retrobulbar neuritis in which intranasal operation was performed, the author discusses in some detail the anatomic relation of the optic nerves to the sinuses and the meninges. He feels that this relation is important in the causation of retrobulbar neuritis in some cases and suggests that surgical treatment is imperative (1) in all cases of optic neuritis, even when recent important malformations of the nose are present, (2) in cases in which there is

no apparent nasal lesion but the symptoms of the neuritis show characteristics which can be interpreted as due to arachnoiditis, and (3) in cases in which improvement does not occur in spite of medical treatment. The author emphasizes the nonspecific character of this surgical procedure. In his opinion a definite etiologic factor, such as multiple sclerosis or syphilis, is not a contraindication to operation if the medical treatment seems to be without effect.

S B MARLOW [ARCH OPHTH]

NEUROTROPHIC VIRUS INFECTIONS AND THEIR OTORHINOLARYNGOLOGIC SYMPTOMS
J DESPONS, *Rev de laryng* **59** 397 (April) 1938

Since the eighth nerve is covered by a meningeal sheath as far as the internal auditory meatus, meningitis readily involves the labyrinth. Secondary syphilis is particularly prone to affect it. Electrical stimulation permits the differentiation of labyrinthine from neural involvement. In lesions of the nerve trunk studies of chronaxia show an elevation of the threshold. In general peripheral lesions of the vestibular apparatus involve the cochlea also. With central lesions, the two are frequently not associated. Romberg's sign is present with peripheral lesions and absent with central ones. The position of the head influences falling in the presence of peripheral lesions only. The author tabulates the vestibular findings useful in locating the level of the central lesion. Since Bell's palsy may be due to an infection instead of cold, vestibular and cochlear examinations should be made. A complete neurologic survey includes a study of the motor activities of the larynx and pharynx, as well as the plotting of areas of sensation in the mucous membranes of these regions. Such complete studies will aid in a concise diagnosis and establish the essential infectious character of many conditions.

BATSON, Philadelphia

ORBITAL INFLAMMATION F CARAMAZZA, *Rev oto-neuro-oftal* **15** 1 (Jan-Feb) 1938

Caramazza describes 12 cases of orbital lesions, in 9 of which the condition was inflammatory.

Two types of inflammatory lesion can be differentiated: a circumscribed type and a diffuse type, the former gives rise to a suppurating cavity and has a much less grave prognosis than the latter, which produces rapidly invasive necrosis of the tissues.

On the first day of the diffuse inflammatory lesion the local and general clinical signs are marked. The general condition is serious, as the disease is septicemic, with an elevated temperature, locally there is rapidly increasing edema. Usually on the second day the edema is not limited to the lids but extends to all the orbital tissues. The ocular bulb becomes compressed, and a disturbance of nutrition takes place, the cornea becomes so edematous that it is impossible to see the iris, and the conjunctiva is chemotic and becomes lardaceous. The general and local symptoms rapidly become more marked, the tissues of the lids, the conjunctiva and the orbital contents become necrotic, and death usually follows, either by pyemia, septicemia or intracranial extension.

Circumscribed inflammation gives rise to the rapid formation of an abscess, and although one cannot exclude the possibility of a fatal outcome, generally a more favorable prognosis can be given. Often one may succeed in saving the globe and occasionally visual function.

In both types osteomyelitic lesions may result.

In all cases of inflammation of sinusal origin Caramazza observed infection of a maxillary sinus, either alone or in conjunction with infection of other sinuses. Also, the most serious orbital infections were always accompanied with maxillary sinusitis.

Therapeutically, the author feels that early cleansing of the orbit and the surrounding infected sinuses should be done

In 1 case of severe diffuse inflammation with gas gangrene Caramazza obtained immediate cessation of the symptoms, both local and general, on exenteration of the orbit and treatment of maxillary sinusitis of dental origin. The result was unusual, as doubtlessly the outcome has always been fatal. Caramazza feels that in all cases of severe involvement systematic surgical cleansing of the orbit and sinuses should be done. This is true, of course, only of such cases, but the cleansing should be done early enough to avoid all intracranial extension.

Twenty-seven photographs and diagrams accompany the article

F P GUIDA [ARCH OPHTH]

NASAL SYNDROME WITH TRIGEMINAL NEURALGIA FOLLOWING A TRAUMATIC LESION OF THE CORNEA F AGNELLO, Riv oto-neuro-oftal **15** 79 (Jan-Feb) 1938

Agnello describes 2 cases of a nasal syndrome with neuralgia of the trigeminal nerve following trauma to the cornea by a finger nail. Symptoms were primarily ocular pain and profuse rhinorrhea. The condition was resistant to local therapy and local anesthesia. Therapy to improve the patient's constitution brought about a rapid disappearance of the neuralgia.

F P GUIDA [ARCH OPHTH]

THE ORIGIN AND TREATMENT OF SPASTIC DYSPHONIA BERENDES, Ztschr f Hals-, Nasen- u Ohrenh **44** 78, 1938

The author classes spastic dysphonia as a symptom complex belonging to a group of psychically related functional disturbances in speech. Locally, there is a disturbance in the motion of the vocal cords, which results in a splitting of the sound into two syllables. This may lead to definite impairment of speech or even aphonia. The disturbance involves not only the larynx but the accessory apparatus of phonation and even the breathing apparatus.

The treatment depends on the psychopathic state of the patient and the environmental conditions and their influence. Psychotherapy must be instituted, and the patient must be trained so that not only does a desire to speak develop but a definite conviction that he will be able to speak properly.

In all such cases the prognosis is good, provided the patient is handled properly. While the otorhinolaryngologist can readily diagnose this condition, the author believes that the treatment really lies in the realm of the psychiatrist.

PERSKY, Philadelphia

THE STATUS AND DANGERS OF CISTERNAL BLOCK AND ITS AVOIDANCE ZANGE, Ztschr f Hals-, Nasen- u Ohrenh **44** 101 1938

The author states that, of the three types of subarachnoid block—that is, the cerebral, obstructing the ventricular openings, the cisternal, obstructing the cisterna magna occipitalis, and the spinal—the cisternal is the most important and most serious. It produces a constriction of a part of the brain substance, usually the cerebellar tonsil, with paralysis of respiration. It may occur as an increase in volume of the contents of the brain, an increase in the contents of a ventricle or a swelling of the brain (due to edema, growth, encephalitis or internal hydrocephalus, hemocephalus or pyocephalus). In meningitis, while block is uncommon, it might occur with cerebral edema. In a series of 70 patients with meningitis, 11 had cisternal block. In 4 of these, the condition had the appearance of a plastic exudative cyst, while in 6 it showed evidence of edema and swelling of the brain and was associated with internal hydrocephalus.

The diagnosis of cisternal block is often difficult for the following reasons:
1. Respiratory paralysis does not present its symptoms until late. The early

symptoms may be obscured by the picture of cerebral or meningeal disease 2 The block does not occur immediately after the spinal tap 3 The diagnosis of cisternal compression cannot be made with the aid of lumbar puncture alone, since disturbances of breathing may occur as a result of the underlying disease If disturbances of breathing occur, then the presence of a block may be surmised A cisternal block, in either of its two forms—that is, the harmless plastic or the dangerous compressive form—can be diagnosed by combined cisternal and lumbar puncture

The block can be prevented by increasing the pressure of the spinal fluid or by ventricular puncture When the block is incomplete, it might be possible to force the brain substance back into the cranial cavity In addition, one should use a ventricular puncture to reduce the increased pressure The author stresses the necessity of care in doing a spinal tap, so that a block is not produced or an existing block overlooked, and especially in the presence of a cerebral tumor The spinal tap is of questionable value in the diagnosis of hydrocephalus internus, and differential diagnosis is possible only through ventricular puncture, which also has a therapeutic effect

In conclusion, while he outlines the value of both lumbar and cisternal lumbar puncture from the diagnostic and therapeutic standpoint, he also warns against the dangers of cisternal block

PERSKY, Philadelphia

THE TREATMENT OF CONGENITAL FISTULA OF THE NECK BY ELECTROCOAGULATION GUSTAV HOFER, *Ztschr f Hals-, Nasen- u Ohrenh* 44 279, 1938

The author reports a series of 8 cases in which cervical fistula (congenital) was treated by electrocoagulation, with complete cure

PERSKY, Philadelphia

News and Comment

CASSELBERRY FUND AWARD

A sufficient sum having accrued from the Casselberry fund for encouraging advancement in the art and science of laryngology and rhinology is now available, in part or as a whole, for a prize award or decoration or to defray the expense of original investigation or research in the domains mentioned

Theses or reports of work must be in the hands of the secretary of the American Laryngological Association, Dr Charles J Imperatori, 108 East Thirty-Eighth Street, New York, before Feb 1, 1940

Society Transactions

AMERICAN LARYNGOLOGICAL, RHINOLOGICAL AND OTOLOGICAL SOCIETY

HAROLD I LILLIE, M D, *President*

Forty-Fifth Annual Meeting, Chicago, May 9, 10 and 11, 1939

E W HAGENS, M D, *Editor of Abstracts*

SYMPOSIUM ON THE CARE OF THE PATIENT AFTER OPERATIONS FOR SEPSIS OF OTITIC ORIGIN

This symposium will be published in full, with discussion, in a later issue of the ARCHIVES

CARE OF MASTOIDECTOMY WOUNDS

COMPLETE MASTOIDECTOMY OPERATION FOR SINUS THROMBOSIS OR OPERATION ON
THE PETROUS PYRAMID DR MARVIN F JONES, New York

The postoperative period may well overshadow the operation, painless dressings, good cosmetic result and a short period of disability are essentials at this time. The suture, drains and dressings vary with operators, my methods are a result of fifteen years' experience. In cases of petrositis the small pathway usually present must be kept open. Removal of granulations is frequently necessary, secondary plastic operation is carried out later. When the approach is via the gasserian ganglion oil silk drains are used, being fixed by large safety pins to prevent change or loss. Wounds should be left alone as much as possible and not overtreated.

RADICAL MASTOIDECTOMY OF THE MODIFIED OR STANDARD TYPE DR J MORRISSET
SMITH, New York

The wound following radical mastoidectomy is often overtreated because of failure to prepare the cavity properly. After making the cavity I line the bony walls with rubber tissue (or gauze treated with liquid petrolatum). If possible the dressing is left out after the second or third change, especially if the cavity is free of blood. When necessary a ring curet is used to remove granulations. In the cavity following the modified radical operation the rubber tissue is placed not in the region of the ossicles but posteriorly. I use a flap operation for closure in such cases.

OPERATION FOR ABSCESS OF THE BRAIN DR HAROLD G TOBLY, Boston

The time of drainage of an abscess of the brain is usually four to five weeks. The site of drainage presupposes thorough mastoidectomy. Operation through a clean wound is carried out according to the case. Direct extension from the mastoid to the abscess of the brain is found with subacute and chronic aural conditions but rarely with acute ones. Various methods of drainage may be discussed, such as simple evacuation and removal of a cone-shaped section of overlying brain tissue by diathermy. Rubber tubing (noncollapsible) or the Mosher wire basket is used in drainage. Irrigations are not carried out. Dressings should be done daily. Iodized poppyseed oil has not proved successful in outlining extensions of

the abscess To reduce pressure and to aid in diagnosis I recommend careful lumbar puncture With cerebellar abscess lumbar puncture may produce serious results

DISCUSSION

DR WESTLEY M HUNT New York I have not had the experience nor the good fortune with modified radical mastoidectomy that Dr Smith has had It has always seemed to me that the success of the care of the cavity after radical mastoidectomy depends on a few simple points The first is complete drainage so that after one finishes the operation one can take a probe and discover no cess-pool That necessitates the taking down, often, of the facial ridge to a considerable degree

The second is closure of the eustachian tube I have as yet found no satisfactory method of being sure of this

The third is the taking down of the hypotympanic area Fourth is an adequate external meatus That is important in the dressing and in proper aeration of the cavity I am not so enthusiastic about the skin graft as I used to be I was taught to place a skin graft over any exposed sinus or dura I do not do that any more because I have seen accidents which I attributed to that procedure

DR ARTHUR C JONES, Boise, Idaho A trick I have picked up in the last few months is the use of the sticker tape which is used in dry goods stores for closing packages I have been using that as sterilized tape for postmastoidectomy dressing when I can take off the bandage It does not irritate the neck, it does not pull the hair, and no secretion forms underneath it

DR J MARION SUTHERLAND, Detroit A balloon is presented, which is inflated after being introduced into the cavity left by radical mastoidectomy through the external auditory canal It keeps the granulations under the same pressure and dilates the external auditory canal

DR J MORRISSET SMITH, New York My present impression about the endaural approach for radical mastoidectomy is that, though I have seen Dr Lempert do the operation very well, it is more difficult for the average surgeon I think he will do a better operation, and probably get along better, with the postauricular incision and the external ear laid out of the way, with free access to the cavity

SYMPOSIUM ON FINAL RESULTS OF OPERATIONS FOR CHRONIC SUPPURATIVE PARANASAL SINUSITIS

This symposium will be published in full, with discussion, in a later issue of the ARCHIVES

CUTS AND CAPTIONS FIVE EDITORIAL YEARS IN RETROSPECT DR LYMAN G RICHARDS, Boston

(The editor of the Transactions presented a discussion of the growth and changes in the character and number of papers presented before the society during the year Difficulties arising in publication of the Transactions were mentioned)

SYMPOSIUM ON VOCAL DEFECTS

This symposium will be published in full, with discussion, in a later issue of the ARCHIVES

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EXPERIENCES WITH FISTULIZATION OF THE LABYRINTH IN CHRONIC PROGRESSIVE DEAFNESS

REPORT OF CASES

EDWARD H CAMPBELL, M D

PHILADELPHIA

The treatment of chronic progressive deafness in the past by any of the conservative measures has been so unsatisfactory that one is apt to grasp with enthusiasm any new procedure that gives a chance for improvement. Fistulization of the labyrinth has been known for many years to give immediate improvement of hearing in typical cases of otosclerosis or in other cases of chronic progressive deafness in which the bone conduction has remained good. The problem of the earlier experimenters in this field has not been so much one of obtaining improvement in hearing by operative means as it has been to maintain the improvement obtained. The surgical procedures used by Holmgren¹ and Sourdille² in the past few years have been successful in obtaining the desired improvement in many cases, but in apparently the great majority of such cases this improvement of hearing has been of short duration, the early regeneration of bone in the labyrinthine fistula resulting in the loss of all improvement obtained by the operation.

The real problem, then, in the attempt to improve the hearing in these cases by surgical means has been the development of a method whereby regeneration of bone in the fistulized labyrinth can be prevented. This problem seems to have been successfully solved by Lempert³ by the use of an electrically driven dental polishing burr to excavate a

From the Department of Otolaryngology of the University of Pennsylvania.
Read before the Section on Otolaryngology of the College of Physicians of Philadelphia, Feb 15, 1939.

1 Holmgren, G. The Surgery of Otosclerosis, *Ann Otol, Rhin & Laryng* **46** 3 (March) 1937.

2 Sourdille, N. New Technique in the Surgical Treatment of Severe and Progressive Deafness from Otosclerosis, *Bull New York Acad Med* **3** 367 (Dec) 1937.

3 Lempert, J. C. Improvement of Hearing in Cases of Otosclerosis. A New One-Stage Surgical Technic, *Arch Otolaryng* **28** 42 (July) 1938.

troughlike fenestria in the bony capsule of the external semicircular canal. The slow shaving down by means of the burr apparently in some way prevents the regeneration of bone and allows the fistula to remain open.

While the use of the burr is probably the main factor in preventing closure of the fistulized labyrinth, an important factor also is the method of closely applying the tympanomeatal cutaneous membrane over the fistula. It seems possible that this close apposition causes contact of the tympanomeatal membrane with the membranous labyrinth and in healing these two membranes become firmly attached by fibrous adhesions. If such adhesions occur it should be sufficient to prevent closure of the area of contact by regeneration of the bony walls of the fistula.

Since the hearing in cases of otosclerosis can be improved by fistulization of the labyrinth and the fistula can be made to remain open by adherence to an exacting technic, one can expect permanent improvement of hearing in cases which are suitable for the operation.

SELECTION OF PATIENTS

Just what type of patient is suitable for the operation is still somewhat uncertain, but, in general, the deafness must be of the conductive type, with good bone conduction, the tympanic membrane must be normal, and the labyrinth must react normally to caloric testing. In estimating the bone conduction an audiogram from the bone conduction receiver of an audiometer is desirable, but it seems doubtful if tests with bone conduction receivers are sufficiently accurate to make such audiograms of practical value. Tuning fork tests give an adequate estimation of the bone conduction, and when it can be shown that the ear responds negatively to the Rinne test and when the Weber test shows lateralization of the tone to the deafer ear, it can be decided that the ear is suitable for operation, at least as far as the bone conduction is concerned.

While it seems desirable in the selection of cases for operation that the tympanic membrane should be normal, it is probably not strictly necessary. If the drum shows some thickening, retraction and scarring as a result of attacks of otitis media, it is probably still suitable for operation, although the results are likely not to be as good as when the drum is normal.

A normally functioning labyrinth appears to be a definite prerequisite for the operation. In one of my cases, although the bone conduction was fair, the labyrinth was apparently dead or much weakened, for on exposing the membranous labyrinth of the external semicircular canal there was no dizziness and no improvement in the hearing. Even when the membranous labyrinth was opened no vertigo or nystagmus followed.

When the case for operation is properly selected, to obtain the best result it is necessary that the surgical technic be closely followed in every detail. While the technic described by Lempert³ is difficult, it is not at all impossible and requires only a knowledge of the anatomy of the parts involved, time and a patience that many will find difficult to acquire. Having had the privilege of closely observing Dr. Lempert's technic in operation in such cases and the advantage of studying his records and interviewing many of the patients on whom he has operated, I have been greatly impressed by the practical improvement in hearing which this operation has given them.

My own experience with the operative treatment of such deaf patients has been limited to 8 cases, in 7 of which the Lempert technic was closely followed, in the remaining case, fistulization of the external semicircular canal was performed after the patient had had a successful radical mastoidectomy. In 2 of the 8 patients operated on I have reopened the fistula in the labyrinth because of its closure by bony regeneration after the first operation.

In the following report of these cases I have emphasized some of the technical errors that may be committed without causing irreparable damage to the parts involved and often without impairing the results of the operation. The amount of loss of hearing for speech has been expressed in percentages with the realization that this is an inaccurate method of determining the degree of practical hearing, in an attempt to compare the hearing before and after operation. The percentages were obtained by multiplying the average reading at the frequencies 512, 1024 and 2048 by 0.8. Bone conduction audiograms obtained by the bone conduction receiver of the audiometer were made in each case, but the instrument used was not considered sufficiently accurate for them to have any practical value. In the estimation of the bone conduction in these cases more reliance was placed on the use of tuning forks. In obtaining records of hearing a masker was used on the better ear in each case.

PREOPERATIVE PREPARATION

In all these cases the following preoperative preparation has been carried out:

1. For two days before operation, instillation (by the patient) in the ear to be operated on of several drops of 70 per cent alcohol four times a day in an attempt to sterilize the operative field.

2. Shaving of the head for 2 inches (5 cm.) around the margin of the auricle the evening before operation.

3. Thorough cleansing of the auricle, adjacent areas and external auditory canal with soap and water followed by alcohol and covering of these areas with a sterile dressing.

4 Administration of $4\frac{1}{2}$ grains (0.3 Gm.) of pentobarbital sodium one hour and a half before operation and hypodermic injection of morphine sulfate $\frac{1}{6}$ grain (0.0108 Gm.) and scopolamine hydrobromide $\frac{1}{150}$ grain (0.0004 Gm.) forty-five minutes before operation

5 Immediately before operation, further application of 70 per cent alcohol to the area to be operated on

With the preoperative sedation described the patient comes to the operating room sound asleep, although he can be roused fairly easily. If he does not appear sufficiently narcotized he is given at the time of operation another $\frac{1}{6}$ or $\frac{1}{4}$ grain (0.0108 or 0.0162 Gm.) of morphine sulfate. If necessary, one or two injections of this drug are given during the course of the operation. The local anesthetic consists of a 1 per cent solution of procaine hydrochloride with sufficient epinephrine to make a

TABLE 1—*Audiometric Recordings Before and After Operation on the Right Ear on June 29, 1938 (Case 1)*

Audiometer Frequencies	Right Ear				Left Ear			
	6/18/38	7/9/38	12/1/38	2/8/39	6/18/38	7/9/38	12/1/38	2/8/39
128	58	29	39	27	42	50	45	48
256	59	37	47	38	43	44	40	40
512	67	47	37	34	55	49	41	39
1024	53	42	37	36	38	42	49	46
1448	57	58	35	37	49	58	60	63
2048	85	73	59	59	67	73	77	81
2900	88	83	73	69	81	83	90	88
4096	88	83	76	84	82	82	84	82
5792	100	100	100	100	100	100	63	70
8192	100	100	100	100	100	100	60	64
Loss of hearing for speech, %	54.7	42.7	35.5	34.4	42.7	43.7	44.8	43.3

1 to 20,000 solution. Only a small amount of this local anesthetic is needed, along the anterior margin of the concha, in the posterior and superior walls of the canal and in the area above the tragus.

REPORT OF CASES

CASE 1—E. H., a man aged 35, an office worker, had had gradually increasing deafness of both ears, especially of the right, for the last seven years, with occasional mild dizziness. He had never had abscesses of the ears. There were no symptoms referable to the nose or throat and no familial deafness. Both drums were normal except for slight thickness. Preoperative hearing tests by audiometer on June 18, 1938, showed (by air conduction) a 54.7 per cent loss in the right ear and 42.7 per cent loss in the left ear. Bone conduction was normal in both ears, with lateralization of the tone to the right.

Operation was performed on June 29, 1938, on the right ear. On July 9, three weeks after operation, hearing tests showed a 42.7 per cent loss in the right ear and a 43.7 per cent loss in the left. On October 18, three and a half months after operation, hearing tests showed a 42.7 per cent loss in each ear. On December 1, five months after operation, the right ear showed a 35.5 per cent loss of hearing, and on Feb. 8, 1939, a 34.4 per cent loss.

Comment—It is now eight months since the operation, and the fistula test produces a moderately active reaction. There has been a 20 per cent improvement in hearing, and although this still leaves the patient with a 34 per cent loss on the side of the operation, the improvement in his hearing has been pleasing and beneficial to him, and many of his friends have complimented him on it. He is now planning to take time from his work to have an operation on the left ear. It is noteworthy that this improvement has resulted in spite of the accidental loss of the skin of the posterior wall of the canal during the operation. This was torn loose from the drum by the drill, and to replace it a plastic skin flap from the lower and anterior wall of the canal was dissected free, stretched across the external auditory canal and placed over the edge of

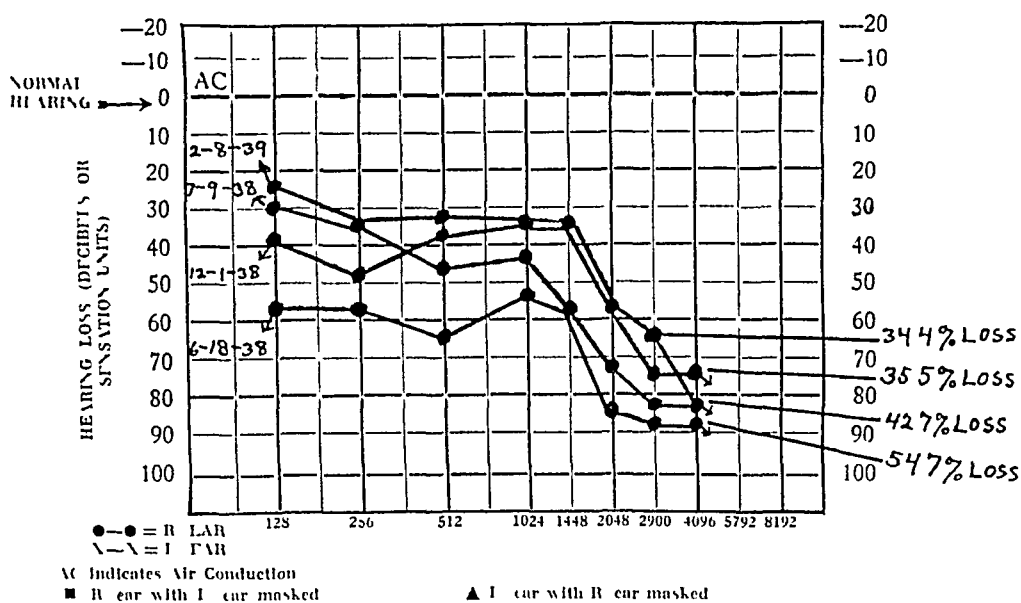


Chart 1 (case 1) —Audiograms showing the hearing in the right ear before and after operation on June 29, 1938

the drum, the incus and the fistula of the external semicircular canal. In healing this has left a firm band stretched across the auditory canal, with the drum visible below it and the area of the aditus and antium above it. The external auditory meatus has been reduced to about one-third its normal size by the fibrosis set up. The tinnitus also has been much reduced in the ear operated on.

CASE 2—S. H., a man aged 43, had noticed gradually increasing noises in both ears with failing hearing for ten years or more. He felt that the noises were becoming unbearable. He was given a course of treatments consisting of inflation of his ears for about two months, without any improvement in the deafness or tinnitus. Tuning fork tests showed considerable loss of hearing in both ears, with some diminishing of bone conduction and no lateralization of tone. Both ear drums were normal. An audiogram on July 12, 1938, showed a 40 per cent loss of hearing in the right ear and a 38.1 per cent loss in the left

Operation was performed on the right ear on July 13. Tuning fork and voice tests after operation showed considerable reduction in the hearing, and it has not improved since.

Comment—The operation on this patient was a complete failure. It was realized before operation that the patient was not an entirely suitable one for the operation because of the poor bone conduction, but it was thought that there was a chance of improving the tinnitus, which was extremely distressing. During the operation, in the process of fistulizing the external semicircular canal the membranous labyrinth was

TABLE 2—*Audiometric Recordings Before and After Operations on the Right Ear on July 20 and Dec 8, 1938 (Case 3)*

Audiometer Frequencies	Right Ear							
	2/17/38	7/1/38	11/8/38	12/5/38	12/17/38	12/24/38	1/10/39	1/17/39
128	37	34	54	53	22	16	15	22
256	45	41	62	58	35	33	36	43
512	48	51	66	67	52	49	60	64
1024	49	53	77	65	42	38	52	52
1448	52	53	70	63	47	45	47	52
2048	56	63	69	64	49	48	54	56
2900	56	55	79	76	63	48	52	51
4096	63	78	100	100	100	77	75	81
5792	100	100	100	100	100	100	100	100
8192	100	100	100	100	100	100	100	100
Loss of hearing for speech, %	40.8	44.8	56.3	52.3	37.9	35.7	44.3	45.6

Audiometer Frequencies	Left Ear							
	2/17/38	7/1/38	11/8/38	12/5/38	12/17/38	12/24/38	1/10/39	1/17/39
128	33	35	55	47	53	49	57	73
256	38	45	47	46	43	41	45	40
512	52	57	51	56	59	62	68	63
1024	36	43	47	43	41	38	38	52
1448	42	45	47	47	46	53	57	52
2048	42	49	51	49	49	50	47	55
2900	52	55	52	53	54	59	63	51
4096	69	81	56	62	69	70	72	81
5792	100	100	100	100	100	100	100	100
8192	100	100	100	100	100	100	100	100
Loss of hearing for speech, %	34.7	39.7	39.7	39.5	39.7	40.3	40.8	39.2

perforated, and in separating the malleus from the incus the latter was dislocated and had to be removed. The vertigo following the operation was severe for five or six days and gradually less for the next three weeks. It appears that the loss of the incus, breaking the conducting chain, is at least a factor in the reduction of hearing that has resulted. The perforation of the membranous external semicircular canal might reasonably be supposed to result in the loss of hearing, but this patient's bone conduction remains as good as and probably better than before the operation, and the tone is lateralized to the ear operated on. There is no fistula reaction, and the tinnitus has not been improved.

CASE 3—C. P., a girl aged 19, complained of gradually increasing deafness and mild tinnitus in both ears, particularly in the right, for four and a half years.

She had never had abscesses of the ear or dizziness. She had had much nasal and tubal treatment without improvement. Neither her father nor her mother was deaf. Both tympanic membranes showed some thickening and areas which were probably scars of suppurative otitis media. The hearing, measured by tuning fork and voice tests, was much impaired in both ears, but more in the right, with normal bone conduction in both and lateralization of tone to the right. On inflation of the eustachian tubes air entered both middle ears easily and well. Adhesions

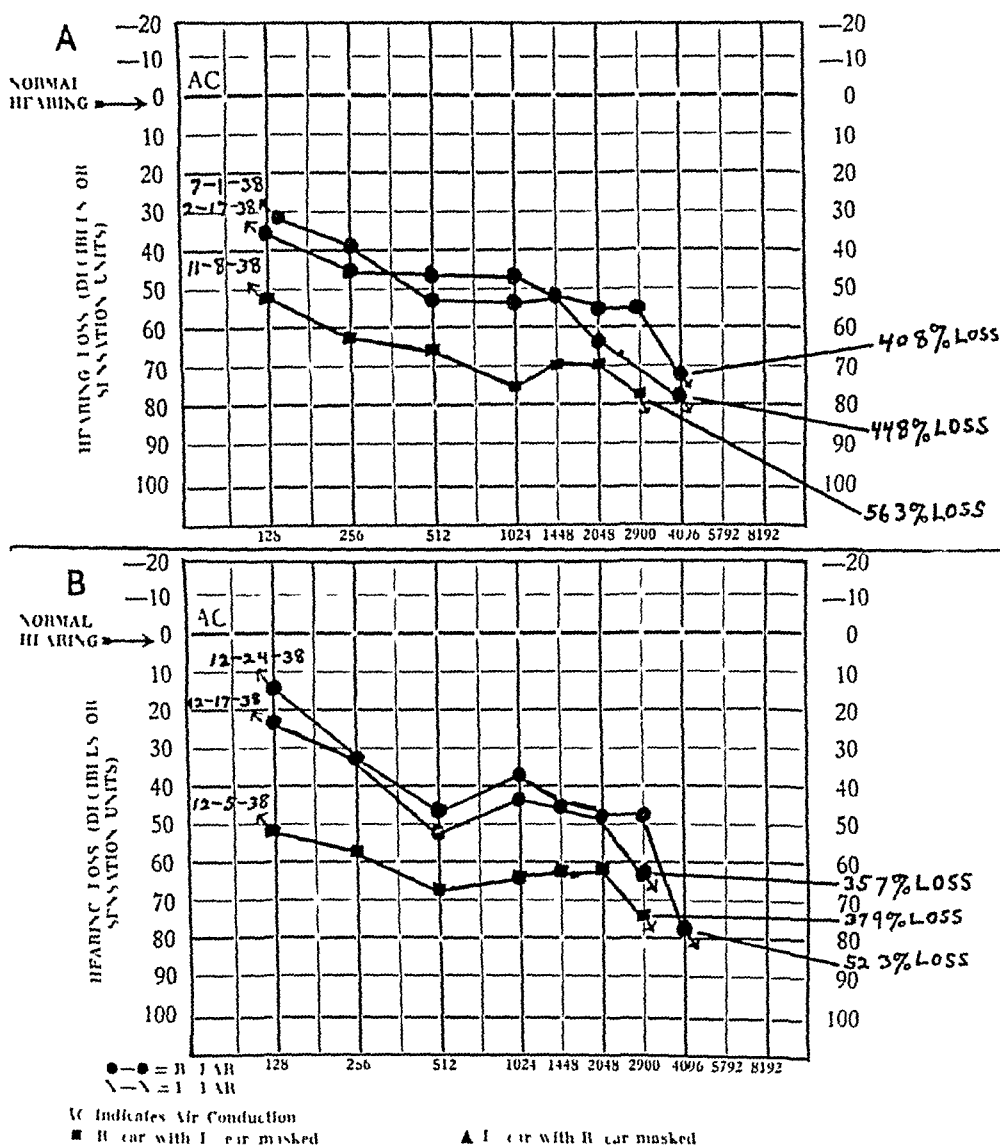


Chart 2 (case 3) —Audiograms showing the hearing in the right ear before and after (A) operation on July 20, 1938, and (B) revision on Dec 8, 1938

were present between the posterior wall of the eustachian tubes and the nasopharynx. An audiogram on Feb 17, 1938, showed a 40.8 per cent loss of hearing in the right ear and a 37.7 per cent loss in the left. During the next four months the patient received frequent inflation treatments, and adhesions were broken up around the eustachian orifices. On July 1 an audiogram showed a 44.8 per cent loss of hearing in the right ear and a 39.7 per cent loss in the left.

Operation was partially performed on the right ear on July 20. Exenteration of the mastoid cells and removal of the bony walls on the posterior and superior

sides of the drum were so difficult and required so much time that the operation was not completed. Two days later the operation was finished by fistulizing the external semicircular canal and fixing the skin flap over the fistula. The hearing was much improved while the patient was on the table, and there was moderate dizziness. The improvement began to fade within a week after operation, at the end of three weeks, it had diminished below what it was before operation, and the fistula reaction had disappeared. On November 8, an audiogram showed a 56.3 per cent loss of hearing in the right ear and a 39.7 per cent loss in the left. This was 11.5 per cent greater than the preoperative loss. One month later, on December 5, the right ear showed a loss of 52.3 per cent. On December 8, operation was again performed on the right ear, the skin overlying the mastoid cavity and the external semicircular canal being elevated and the canal reopened by means of the burr. There was considerable vertigo, and the hearing was markedly improved while the patient was on the table. The skin flap was then replaced over the fistula. On December 17 (nine days after operation) an audiogram showed a 37.9 per cent loss of hearing in the right ear (an improvement of 14.4 per cent over the preoperative hearing). One week later an audiogram showed a 35.7 per cent loss (an improvement of 16.6 per cent over the preoperative hearing). On Jan. 10, 1939 (three weeks later), the right ear showed a 44.3 per cent loss, and one week later, January 17, the loss was 45.6 per cent.

Comment—This case well illustrates the difference there may be between the percentage of improvement in hearing registered by the audiometer and the practical improvement registered by the patient. She can now hear conversation, which was not audible before, and can enjoy moving pictures. She is happy about the improvement, and her outlook on life has changed for the better. The question is whether this improvement in hearing will be maintained. In the past month some of the improvement has been lost, the percentage of loss going from 35.7 to 45.6. Is bony regeneration of the labyrinth again taking place? She still has a fistula reaction, but this is not so active as it was two weeks ago. I doubt that her improvement in hearing will be maintained.

CASE 4—E. W., aged 21, a salesgirl, had noticed rapidly increasing deafness for about five months, with tinnitus, which had recently become severe in the right ear. There was no dizziness or pain in the ears. She had never had abscesses of the ears. A sister had been deaf since childbirth, but there was no other history of deafness in the family. She was not especially subject to colds in the nose, and there was no trouble with the throat. She had received no treatment of the ears but considerable of the nose. Both ear drums were normal, except possibly for slight thickness. Both eustachian tubes inflated easily and well without improvement in hearing.

Tuning fork and voice tests showed considerable impairment of hearing in both ears, with normal bone conduction in both and lateralization of tone to the right. An audiogram on Aug. 25, 1938, showed a loss of hearing of 35.5 per cent in the right ear and 27.7 per cent in the left ear.

Operation was performed on the right ear on August 29. Opening the external semicircular canal caused mild dizziness and considerable improvement in hearing. When the gauze packing was removed from the wound, at the end of a week, the hearing was still improved, and the fistula reaction was active. During the next two weeks, however, the hearing gradually failed, until one month after

operation it was worse than before and the fistula reaction was absent. On October 6 (five weeks after operation) an audiogram showed a 36.3 per cent loss of hearing in the right ear and a 25.3 per cent loss in the left. Seven weeks later on November 26, the right ear showed a 41.3 per cent loss and the left ear a 28.5 per cent loss. On December 29 the loss was 36.8 per cent in the right ear a decrease of 9 per cent from the hearing before the operation, and 27.5 per cent in the left ear.

On Jan. 5, 1939, reoperation was done, the skin overlying the mastoid cavity and the external semicircular canal being elevated and the semicircular canal reopened with the burr. The membranous labyrinth was exposed over a wide

TABLE 3—*Audiometric Recordings Before and After Operations on the Right Ear on Aug. 29, 1938, and Jan. 5, 1939 (Case 4)*

Audiometer Frequencies	Right Ear							
	8/25/38	10/6/38	11/26/38	12/29/38	1/14/39	1/17/39	1/25/39	2/7/39
128	37	56	58	55	67	62	57	42
256	46	51	58	56	70	67	61	52
512	49	52	57	52	75	65	57	44
1024	46	48	53	48	49	47	38	37
1448	48	37	40	37	35	28	33	32
2048	28	26	45	38	32	33	33	32
2900	42	40	42	48	35	32	22	22
4096	42	70	67	73	62	63	64	53
5792	66 ⁹	100	100	100	100	100	100	100
8192	100	100	100	100	100	100	100	100
Loss of hearing for speech, %	35.5	36.3	41.3	36.8	40.8	37.9	33.3	30.4

Audiometer Frequencies	Left Ear							
	8/25/38	10/6/38	11/26/38	12/29/38	1/14/39	1/17/39	1/25/39	2/7/39
128	45	48	45	39	42	41	45	50
256	42	45	45	40	39	41	43	48
512	42	37	43	43	48	45	48	51
1024	40	40	42	37	38	37	34	33
1448	33	27	34	33	30	32	38	37
2048	22	18	22	23	26	25	23	25
2900	39	27	30	34	38	41	43	45
4096	69	57	62	58	53	55	59	63
5792	100	100	100	100	100	100	100	100
8192	100	100	100	100	100	100	100	100
Loss of hearing for speech, %	27.7	25.3	28.5	27.5	30.1	28.5	28	28.5

area, without injury to it. The skin flap was then replaced and fixed in position with gauze packing. There was mild dizziness and the hearing was again much improved while the patient was on the operating table. (Slight whispering was distinctly heard.) On January 14 (nine days after operation) an audiogram showed some loss of hearing for the three lowest tones but an improvement for the middle tones (the total loss being 40.8 per cent). Three days later there was an improvement to a 37.9 per cent loss of hearing and one week later to a 33.3 per cent loss, on February 7 the loss was 30.4 per cent.

Comment—The result in this case is still somewhat in doubt. At the original operation the hearing was so markedly improved when the labyrinth was opened that a good result was anticipated. As the labyrinthine fistula gradually closed the hearing became steadily worse, until it was 9 per cent below its level before operation. At the second operation, when the external semicircular canal was again fistu-

lized, there was again marked improvement in hearing measured by voice tests. However, when the gauze packing was removed, on the eighth day, an audiogram showed the hearing unimproved. Since then audiograms taken at intervals of three to seven days have shown a steady improvement of hearing, and the last one (taken on Feb 7, 1939) showed a 30.4 per cent loss of hearing, an improvement of 11 per cent

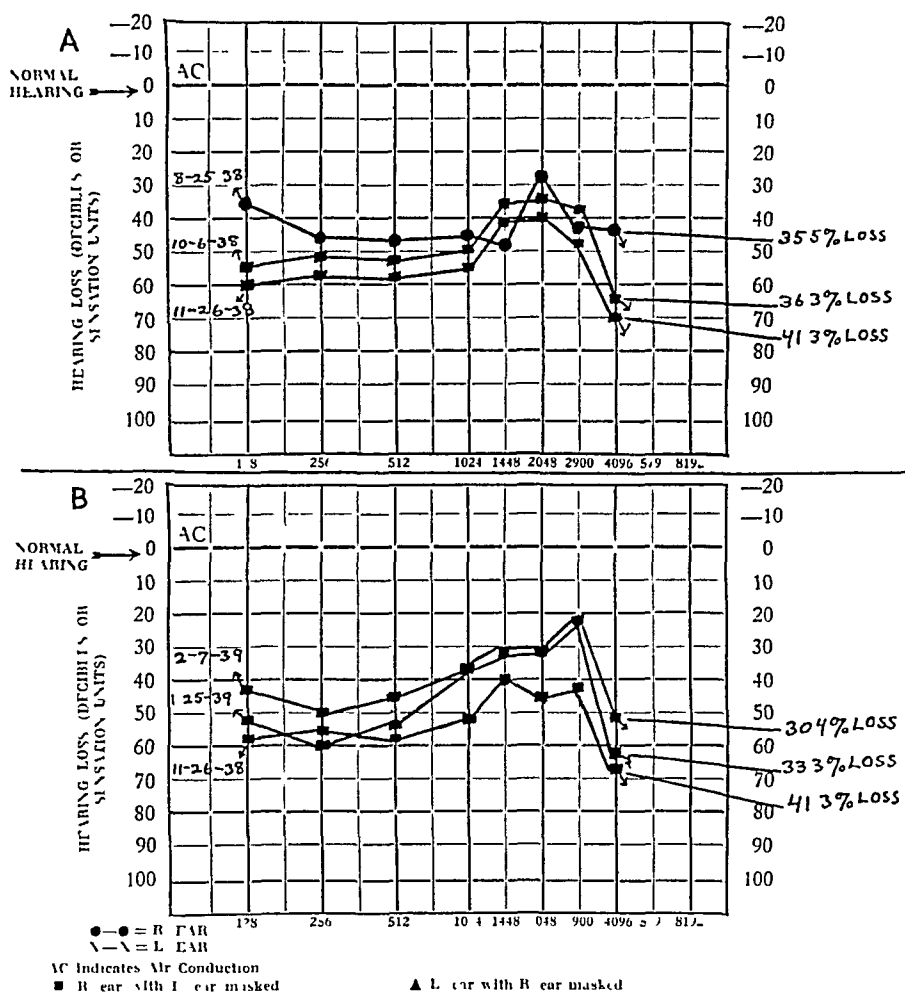


Chart 3 (case 4)—Audiograms showing the hearing in the right ear before and after (A) operation on Aug 29, 1938, and (B) revision on Jan 5, 1939

since before the second operation. The fistula reaction is active, and I believe there will be further improvement as the inflammatory reaction of the skin surface subsides and the thick exudative fluid secretion overlying the operative area becomes less.

CASE 5—N. G., a woman aged 44, had had a radical mastoidectomy on the right at 15 years of age because of a constant running ear for the previous ten years. The ear healed promptly and since the operation had remained dry but

had shown considerable impairment of hearing with marked tinnitus. For the past fifteen years there had been an intermittent discharge of pus from the left ear, which for the past two years had been practically constant. The patient had noticed gradually increasing deafness also in the left ear. Tuning fork tests showed a moderate impairment of hearing in both ears, slightly more marked in the right, with normal bone conduction in both and lateralization of tone to the right ear. The right ear showed a rather large excavated mastoid process, with a thin skin completely covering this area and also the region of the antrum, the aditus and the inner wall of the middle ear. The left drum showed a large central perforation, partly filled in by granulation tissue and overlaid by thick, foul pus. An audiogram on Sept. 26, 1938, showed a 25.9 per cent loss of hearing in the right ear and a 28 per cent loss in the left ear.

On September 30 operation was performed on the right ear. Through an endaural incision the skin overlying the cavity of the mastoid, the antrum and the aditus was elevated and displaced anteriorly, with exposure of the external semicircular canal. This was worn down by the burr and the membranous

TABLE 4—*Audiometric Recordings Before and After Operation on the Right Ear on Sept 30, 1938 (Case 5)*

Audiometer Frequencies	Right Ear				Left Ear			
	9/25/38	10/14/38	11/23/38	1/17/39	9/26/38	10/14/38	11/23/38	1/17/39
128	46	66	58	45	41	34	22	25
256	46	65	55	46	42	39	26	25
512	40	72	53	46	47	47	32	41
1024	29	51	36	34	36	22	16	14
1448	41	62	37	35	34	20	17	14
2048	28	55	25	26	23	20	13	16
2900	40	67	24	23	35	33	23	10
4096	47	63	32	40	52	54	32	54
5792	51	56	36	48	38	41	44	37
8192	40	46	36	47	33	35	26	27
Loss of hearing for speech, %	25.9	47.7	30.1	28.3	28	23.7	16.5	16

labyrinth exposed. This procedure resulted in considerable dizziness, with nausea and much improvement in hearing. The skin flap was then replaced and held firmly in position by gauze packing. The operation was followed by intense dizziness and frequent vomiting and nystagmus until the gauze packing was loosened somewhat and part of it removed. Severe dizziness, however, persisted for several weeks, even after all packing had been removed but became gradually less during the second month after operation. During this period of intense dizziness the hearing was worse than before operation, but as the dizziness subsided the hearing improved. An audiogram on October 14 showed a 47.7 per cent loss of hearing in the right ear, compared with a 25.9 per cent loss before the operation. On November 23 an audiogram showed a 30.1 per cent loss in the right ear and a 16.5 per cent loss in the left ear. On Jan 17 1939, the right ear showed a 28.3 per cent loss, 2.4 per cent greater than the loss before operation, and the left ear showed a 16 per cent loss.

Comment—The result in this case shows that it takes more than fistulization of the labyrinth to improve the hearing. Here the external semicircular canal was widely opened and a thin skin placed firmly over it. The fistula has remained open but the hearing has not been

improved. It emphasizes the necessity of a mechanism in the middle ear, that is, a normal or nearly normal drum and tympanic cavity to obtain the greatest amount of improvement in hearing.

During the three and one-half months since the operation the hearing of the ear not operated on has improved 12 per cent, because persistent treatment of that ear has resulted in considerable lessening of the granulation tissue and the discharge of pus. The amount of dizziness in this patient was unusual and, I believe, was due to the setting up of serous labyrinthitis from too much manipulation of the membranous labyrinth. While in this case the labyrinthitis appeared to subside, it is conceivable that such a condition might lead to the destruction of both labyrinthine and cochlear functions.

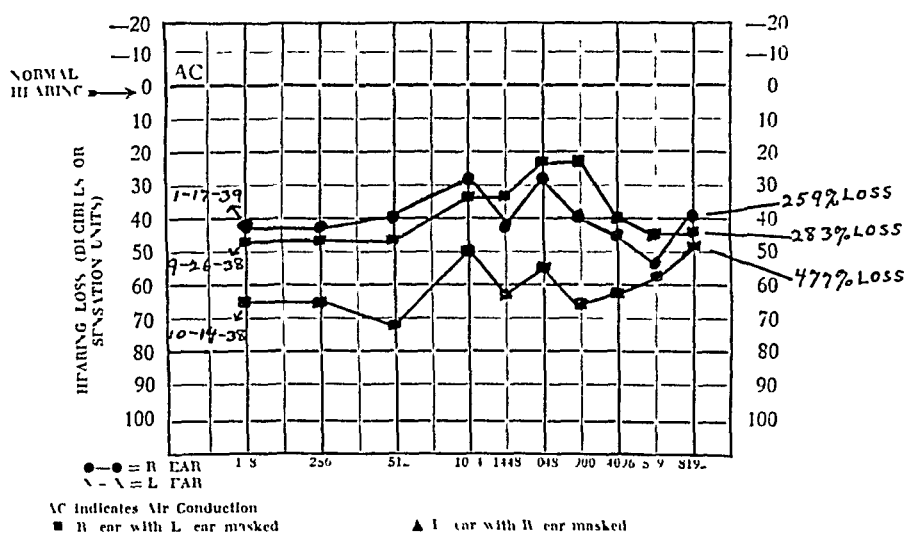


Chart 4 (case 5) — Audiograms showing the hearing in the right ear before and after operation on Sept 30, 1938

At present, there is no dizziness except on quick movement of the head, the fistula reaction is active and the wound entirely healed. Although improvement of hearing has not been demonstrated audiometrically, the patient asserts that she has much better hearing. This is probably largely due to the considerable lessening of the tinnitus since the operation and the improvement of hearing in the left ear.

CASE 6—N. C., a woman aged 38, a hand dresser, had noticed gradually increasing deafness in the right ear for twenty years, with severe tinnitus, and increasing deafness of the left ear since an abdominal operation five years previously. For the past few years she had had considerable treatment of the ears, including inflation, without improvement of the hearing. A history of abscesses of the ears or familial deafness was not elicited. The tonsils had been removed about twelve years previously. The patient had not had operations on the nose or chronic

TABLE 5—Audiometric Recordings Before and After Operation on the Right Ear on Oct 12, 1938 (Case 6)

Audiometer Frequencies	Right Ear					Left Ear				
	9/26/38	10/22/38	11/5/38	12/5/38	12/12/38	9/26/38	10/22/38	11/5/38	12/5/38	12/12/38
128	65	58	43	47	52	77	68	73	70	68
256	70	48	70	54	54	73	69	75	70	66
512	85	47	45	48	57	76	82	77	70	70
1024	80	37	48	48	42	67	70	64	63	68
1448	80	37	43	41	42	68	70	68	63	63
2048	65	35	46	42	42	39	45	55	38	48
2900	65	57	53	35	32	46	43	47	43	48
4093	77	72	74	53	55	67	75	68	77	73
5792	100	100	100	100	100	68	65	100	67	100
8192	100	100	100	100	100	100	100	100	100	100
Loss of hearing for speech, %	61.6	31.7	37.1	35.7	37.3	48.8	52.5	52	45.6	49.9

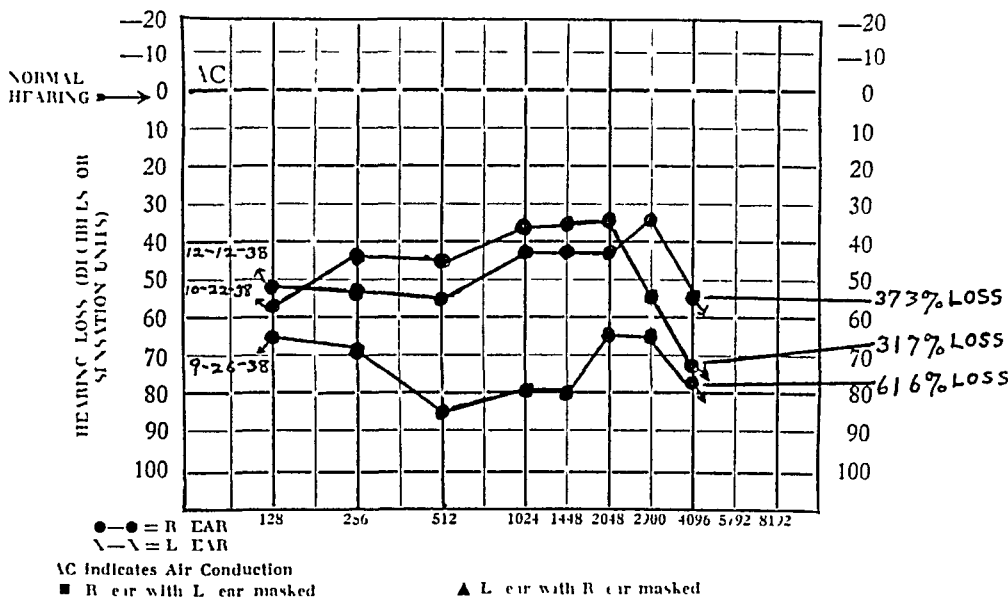


Chart 5 (case 6)—Audiograms showing the hearing in the right ear before and after operation on Oct 12, 1938

nasal symptoms Tuning fork tests showed profound deafness of the right and considerable deafness of the left ear, with normal bone conduction in both ears and lateralization of tone to the right Examination showed the right drum normal except for slight thickness On the posterior quadrant of the left drum was a round elevated area appearing like a blister, which was apparently a thin layer of skin covering an old perforation in the drum and which had been ballooned outward by repeated inflation of the ear An audiogram on Sept 26, 1938, showed a loss of hearing in the right ear of 61.6 per cent and in the left ear of 48.8 per cent

On October 12 operation was performed on the right ear Exposure of the membranous labyrinth of the external semicircular canal caused considerable dizziness and much improvement in hearing, measured by voice tests For several days after operation the dizziness was severe, with vomiting and nystagmus This condition was improved somewhat by removal of some of the gauze packing and loosening of the remainder The severe dizziness persisted for several weeks after discharge from the hospital but gradually became less, and as it subsided

the hearing improved. On October 22 an audiogram showed a 31.7 per cent loss of hearing in the right ear and a 52.5 per cent loss in the left. On December 12 the loss of hearing was 37.3 per cent in the right ear and 49.9 per cent in the left.

Comment—Although there is still a loss of hearing in the right ear of 37 per cent, the practical improvement has been more than is indicated by the audiometer record. This patient is immensely pleased with the result obtained, as she gets along well with ordinary conversation, and has given up the idea of getting a hearing aid, which she had planned before the operation to obtain. She is planning to have the other ear, which still shows a loss of 49.9 per cent in hearing, operated on. It has now been four months since the operation, and, as the fistula reaction remains active, it seems likely that there will be no bony regeneration to cover the fistula.

TABLE 6—*Audiometric Recordings Before and After Operation on the Left Ear on Oct 19, 1938 (Case 7)*

Audiometer Frequencies	Right Ear				Left Ear			
	5/11/38	9/24/38	12/10/38	1/21/39	5/11/38	9/24/38	12/10/38	1/21/39
128	33	41	42	43	65	48	100	100
256	38	43	48	43	65	47	100	100
512	48	53	45	46	62	53	97	100
1024	58	62	63	62	67	62	95	96
1448	55	54	55	53	58	52	91	90
2045	56	60	58	51	76	84	100	90
2900	56	62	58	56	80	86	94	100
4096	62	67	73	55	86	90	100	100
5792	100	100	100	100	100	100	100	100
8192	100	100	100	100	100	100	100	100
Loss of hearing for speech, %	43.2	46.9	43.3	42.4	54.4	53.3	77.3	76

CASE 7—L. H., a boy aged 14, first noticed deafness at 9 years of age. Since then his hearing had been rapidly getting worse in both ears with buzzing noises in both. In the past two years he had been studying lip reading and had gained considerable proficiency in it. A tonsillectomy was performed at 5 years of age. During his early life he had many abscesses, in both ears. A history of deafness in the family was not elicited. Both ear drums showed some thickening, retraction and scarring but no perforations.

Tuning fork and voice tests showed marked impairment of hearing in both ears, with probably decreased bone conduction and lateralization of tone to the right. An audiogram on Sept. 24, 1938, showed a 46.9 per cent loss of hearing in the right ear and a 53.3 per cent loss in the left.

On October 19 operation was performed on the left ear. When the bony labyrinth had been removed and the membranous labyrinth exposed, there was no dizziness and no improvement in hearing. More extensive removal of the bony labyrinth in an attempt to cause dizziness and give improvement in hearing while the patient was on the table resulted in perforation of the membranous labyrinth. The opening was covered promptly by the skin flap and the operation completed. There was no postoperative dizziness or nystagmus. After the operation the hearing

was obviously worse, and on December 10 (nearly two months after operation) an audiogram showed a 77.3 per cent loss of hearing in the right ear and a 43.3 per cent loss in the left. Subsequent tests, up to the time of writing, showed no improvement of hearing in the ear operated on. The bone conduction, however, remained as before operation, definitely present but decreased from the normal.

Comment—The patient was not suitable for operation because of poor bone conduction and a considerably weakened or dead labyrinth. The condition of the labyrinth was not determined before operation. It appears desirable to do a caloric test on all patients as a preliminary to the operation, to determine the status of the labyrinth. A dead labyrinth should be a contraindication for the operation. Too much zeal in exposing the membranous labyrinth in this case resulted in its perforation. However, it seems more likely that the breaking of the

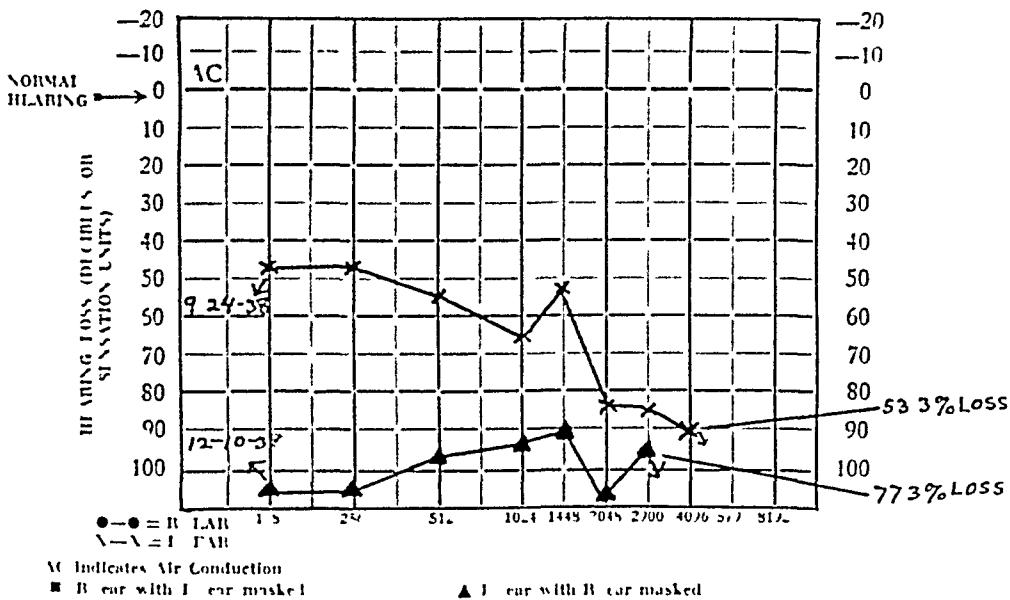


Chart 6 (case 7)—Audiograms showing the hearing in the left ear before and after operation on Oct 19, 1938

ossicular chain by excision of the head of the malleus caused the increase in deafness rather than the opening of the dead labyrinth. The cochlear function certainly was not destroyed, as there was response to some of the audiometer frequencies and the bone conduction was not lost.

CASE 8—F. B., a married woman aged 40, first noticed deafness of the right ear six years previously, in association with an acute sinus infection. Since then the deafness had steadily increased, with increasing tinnitus, and for the past four years there had been gradually increasing deafness and tinnitus of the left ear. There was no dizziness. The patient had had much treatment by otologists of various cities and by an osteopath, with no improvement. There was no history of abscesses in the ears. The father had had a similar type of deafness and died at 75. Scarlet fever had left the mother partially deaf in one ear. Three older sisters had no deafness.

Examination showed both ear drums normal except for slight thickness. Tuning fork and voice tests showed profound deafness of the right ear and considerable of the left, with normal bone conduction in both and lateralization of tone to the right. On inflation air entered both middle ears easily and well. On Nov. 19, 1938, an audiogram showed a 62.4 per cent loss of hearing in the right ear and a 40 per cent loss in the left. On December 29 an audiogram showed a 61.1 per cent loss of hearing in the right ear and a 41.6 per cent loss in the left. Another check-up, preliminary to operation, showed on Jan. 5, 1939, a 61.9 per cent loss in the right ear and a 40.3 per cent loss in the left ear.

On January 11 operation was performed on the right ear. Exposure of the membranous labyrinth of the external semicircular canal caused moderate dizziness.

TABLE 7—*Audiometric Recordings Before and After Operation on the Right Ear on Jan. 11, 1939 (Case 8)*

Audiometer Frequencies	Right Ear					
	11/19/38	12/29/38	1/5/39	2/6/39	2/11/39	2/14/39
128	64	53	56	19	27	13
256	59	56	55	24	23	13
512	72	73	74	47	32	37
1024	72	68	68	32	32	27
1448	87	84	85	42	41	37
2048	89	86	90	44	41	37
2900	85	92	90	69	68	67
4096	100	100	100	100	100	100
5792	100	100	100	100	100	100
8192	100	100	100	100	100	100
Loss of hearing for speech, %	62.4	61.1	61.9	32.8	28	27.2

Audiometer Frequencies	Left Ear					
	11/19/38	12/29/38	1/5/39	2/6/39	2/11/39	2/14/39
128	37	27	26	43	41	40
256	37	33	33	40	46	49
512	37	42	41	37	41	42
1024	47	48	46	48	51	52
1448	53	53	55	57	52	53
2048	64	66	63	65	60	64
2900	63	66	57	55	59	60
4096	74	82	78	79	73	85
5792	100	62	100	100	100	100
8192	100	100	100	100	100	100
Loss of hearing for speech, %	40	41.6	40.3	40	40.5	41.9

and considerable improvement in hearing measured by voice tests. Near the finish of the operation, in smoothing off some of the bony edges with the drill, the delicate skin flap of the posterior canal wall was caught in the burr. This not only resulted in severely tearing the flap but also caused a ragged laceration across the drum. The edges of these lacerations were approximated as accurately as possible and the remnants of skin deflected so as to cover the malleus, the incus, the epitympanic space and the fistula of the external semicircular canal. The skin was held closely in place by small pieces of gauze mesh. The operation was followed by moderate dizziness for a few days. When the packing was all removed, on the tenth day, the patient noticed distinct improvement in hearing, and the fistula reaction was active. On February 6 an audiogram showed much improvement in the ear operated on, particularly for the low tones, the right ear showing only a 32.8 per cent loss, an improvement of 29.1 per cent since the operation, and the left ear still showing a loss of 40 per cent. One week later the hearing of the right ear was further improved, to a 27.2 per cent loss.

Comment—It is of course entirely too soon after operation to tell what will be the final result for this patient. At present, the hearing is greatly improved, and the patient is immensely pleased with the result. The lacerated drum and skin of the posterior wall of the canal are healing well, and it looks as if the drum would entirely heal. There is still some swelling of the tissues throughout, and it seems possible that as this swelling subsides hearing will be further improved. The fistula reaction is active, and as it has shown no lessening during the six weeks since operation it seems probable that the fistula will not be closed by bony regeneration. In this case also the practical improvement in hearing was much greater than that indicated by the audiograms, 35 per cent.

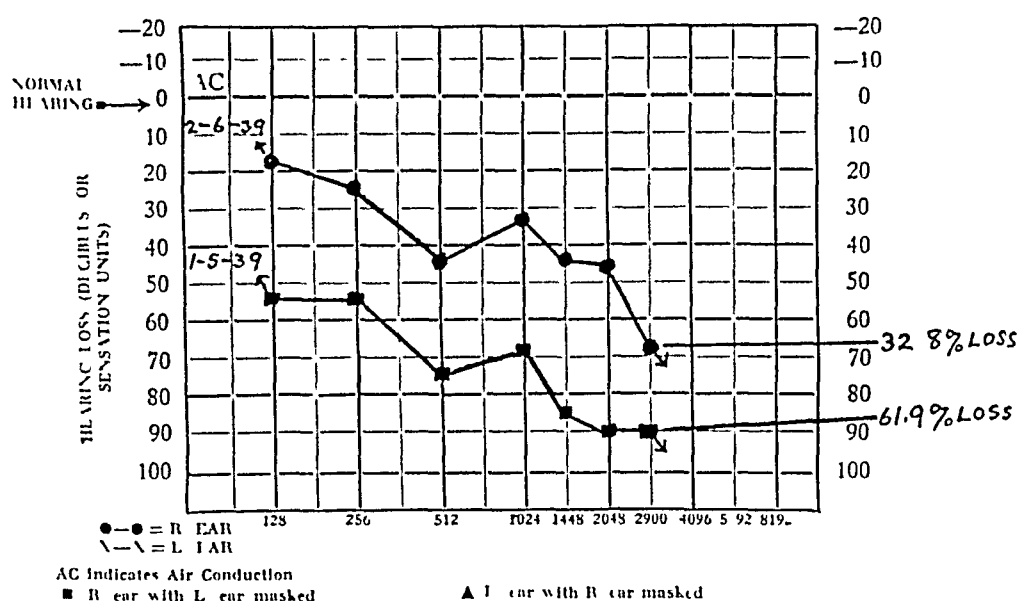


Chart 7 (case 8)—Audiograms showing the hearing in the right ear before and after operation on Jan 11, 1939

CONCLUSIONS

An analysis of the 8 cases here reported in which an attempt has been made to improve the hearing by means of fistulization of the labyrinth will reveal results of varied character and will perhaps permit certain deductions or conclusions. I should classify the results which have been obtained as excellent in 2 cases, as there has been considerable improvement in hearing for the critical frequencies as recorded by the audiometer and, what I believe is more important, a practical improvement of hearing which has been extremely gratifying to the patient. In another case (the first reported) the improvement has been fair, sufficient to give the patient considerably more comfort in his occupation as a clerk and to make him plan to have the other ear operated on to gain additional improvement. In 2 other cases the hearing was made worse at first by the closure of the fistula. On

reoperation one of the patients has been much pleased at the improvement thus far obtained, and the audiometer has shown further improvement at each weekly interval since the operation, five weeks ago. The other patient operated on a second time showed satisfactory improvement for a few weeks, but recently this improvement is being lost, and the eventual outcome does not look promising.

In 2 of the 8 cases hearing by air conduction has been made worse, although the bone conduction remains unchanged from the preoperative level. The failure has been due partly to the unsuitability of the cases for the operation and partly to the opening of the membranous labyrinth. In 1 of these cases there was no useful hearing in the ear operated on before operation, and the patient is unaware that his hearing is worse, as the bone conduction has not changed, he can still obtain hearing by a bone conduction hearing aid if he desires one. In the other case, although the hearing is worse, the patient appears to be concerned only about the tinnitus, which had been distressing and which was not improved by the operation. In the case in which the labyrinth was fistulized after radical mastoidectomy little or no improvement has been recorded, although the patient insists that her hearing is better.

One thing has been impressive in operating on these patients and that is the importance of adhering strictly to the described technic if good results are to be effected. There are many points at which a slip-up may occur and cause failure or partial failure to obtain a good result. It is easy to lacerate the delicate skin of the posterior wall of the canal or to lacerate or perforate the drum in the removal of the sulcus tympanicus. In separation of the malleus from the incus preliminary to amputation of the head of the malleus the incus may become loosened and require removal. The proper handling of the external semicircular canal is of the greatest importance. The bony labyrinth must be removed in a groove or trough shape by means of the burr to an extent sufficient to expose a rather wide area of membranous labyrinth without injury to it. Then, of extreme importance is the fitting of the tympanomeatal cutaneous membrane over the fistula so closely as to make contact of this membrane with the membranous labyrinth. This close fitting of membrane over the fistula may have much to do with the prevention of its subsequent closure by bony regeneration.

DANGERS OF THE OPERATION

Mortality—There should be no fatality if strict asepsis is maintained. Even though the membranous labyrinth were destroyed or the dura perforated, septic labyrinthitis or meningitis would not occur in the absence of infecting organisms.

Injury to Cartilage—It is possible that cartilage of the ear may be injured or cut, but, again, if strict asepsis is observed chondritis or perichondritis will not develop.

Injury to the Labyrinth—Destruction of the labyrinthine and possibly also of the cochlear functions may result from injury or rupture of the membranous labyrinth. On the other hand, it seems possible that an opening of the membranous labyrinth if sealed promptly by the tympanomeatal cutaneous membrane, may heal itself without impairment of either the labyrinthine or the cochlear functions.

Injury to the Facial Nerve—The facial nerve may be paralyzed if injured, but this should not occur with careful technic. It has twice been my experience to expose the facial nerve adjacent to the external semicircular canal without resultant paralysis, perhaps because in this area the operative work is done so slowly and carefully that even though the facial nerve is exposed it may be recognized and not injured, so that paralysis will not result.

Injury to the Tympanic Membrane—The tympanic membrane may be perforated or lacerated but should heal promptly in the absence of infection.

Dislocation of the Incus—The incus may be accidentally removed. If the rest of the operation is successfully performed its removal may cause little or no impairment of the result. However, if bony regeneration closes the labyrinthine fistula, the impairment of hearing will be greater than before the operation, because the break in the ossicular chain will prevent sound impulses from reaching the internal ear through the normal conducting channel. It is assumed that in cases suitable for operation fixation of the stapes in the oval window prevents the conduction of sound impulses. However, the degree of fixation of the stapes varies in cases of conductive deafness so that in many of them some impulses are transmitted through the stapes. Accidental dislocation of the incus will prevent such impulses from getting through, and a decrease in hearing will result if the fistulization of the external semicircular canal is not successful.

Decrease of Hearing—A decrease of hearing, then, appears to be one of the most serious consequences of an improperly performed operation. If, however, there has been no practical hearing before operation, the further impairment of the hearing will be of little concern. Even if there has been some useful hearing before the operation, the nature of the condition is such that progressive impairment (sometimes rapid) of the hearing is to be expected, and a sudden decrease caused by an accident at operation may be only hastening the eventual outcome.

POSTOPERATIVE REACTIONS AND COMPLICATIONS

No serious postoperative reactions or complications have been observed in my cases.

Dizziness—The dizziness that occurs with the patient on the operating table when the labyrinth is opened is usually prolonged for a few

days The amount of this vertigo is dependent to some extent on the firmness of the gauze packing overlying the fistula and probably also on the amount of trauma which the membranous labyrinth has received during exposure In 2 of my cases severe dizziness followed the operation, lasting four to six weeks I attributed this prolonged reaction to the setting up of serious labyrinthitis from trauma to the membranous labyrinth In both cases it subsided and has left an active fistula reaction In the majority of cases the dizziness gradually subsides within a few days, so that when the gauze packing is removed, on the eighth day, the patient is able to walk out of the hospital without help

Pain—Postoperative pain is usually so slight as to require no sedatives for its control

Temperature—There is little or no rise in temperature after operation In one of my cases active follicular tonsillitis developed on the second postoperative day The temperature rose to 102 F for three days, but thereafter it became normal, and the tonsillitis subsided in the usual time

Healing of the Wound—Considerable thick exudative moisture is present in the operative area, covering the walls of the canal and the drum Granulation tissue forms in the posterior part of the wound, in the excavated mastoid area and around the border of the concha Sometimes this is excessive and requires burning down with trichloroacetic acid (25 per cent) or a strong solution of silver nitrate In my cases the operative area remained moist, with granulation tissue which required burning for two to four months Eventually the wound becomes dry and is entirely covered with skin and the opening of the wall of the canal shrinks to its normal size, leaving no indication that the ear has been operated on

State of Hearing During Convalescence—During the week immediately following operation, while the gauze packing remains in the ear, little idea of the degree of hearing can be gained After the packing is removed, however, if the operation is successful, a distinct improvement is usually noticeable However, improvement may be delayed several days or weeks longer, because of reaction of the tissues Trauma to the tympanic membrane and the reflected skin of the wall of the canal may cause such swelling and edema, with perhaps some hemorrhage into the cavity of the middle ear, that improvement of hearing is delayed until this reaction has subsided Furthermore, the development of severe labyrinthitis also may delay the improvement Probably the greatest improvement in hearing is present while the patient is on the operating table when the labyrinth is opened Afterward the reactions of the tissues cause a lessening of the hearing from that observed with the patient on the table, and although there is further steady improvement as the reactions of the tissues subside and healing occurs, it is

doubtful if the improvement in hearing again reaches the level observed while the patient is on the operating table. When the wound has de-epithelialized completely and all exudate ceased, the hearing has probably reached its height of improvement. This takes from two to four months. When the operation is rendered unsuccessful by closure of the fistula by bony regeneration, hearing is improved during the first week or two after operation, but the improvement is rapidly lost thereafter until it becomes worse than before the operation, as the fistula closes. In the 2 cases of mine in which this occurred the improvement in hearing had been lost and the fistula closed, as determined by absence of the fistula reaction, at the end of four weeks.

If one can draw a conclusion from results obtained in such a small number of cases, it is that definite improvement of hearing in properly selected cases of conductive deafness can be obtained by fistulization of the labyrinth according to the technic described by Lempeit³. In evaluating the results obtained it is important also to consider the effect of the operation on the tinnitus nearly always associated with the deafness. In the cases reported here in which there has been an improvement in the hearing there has also been a lessening of the tinnitus, and this has been particularly pleasing to the patient.

What amount of improvement in hearing may be expected in patients properly selected and operated on is a question that may properly be asked. From my own experience I believe an improvement of 35 per cent may be expected, or an improvement of 40 to 45 decibels in the middle and lower frequencies. When this is realized it is evident how important it is to operate in such cases of progressive deafness before the deafness has become too great.

To determine accurately the amount of improvement that may be obtained with this operation will require the experience of many operators in many additional cases. It is important, therefore, that more cases be reported, with observations and comments, as fast as possible, in order that more knowledge may be gained of a therapeutic procedure that appears to have given great advancement in the treatment of a condition that was formerly discouraging. Considerable experimental research also is necessary to clarify some of the doubtful points associated with the physiology and pathology of the mechanism of the internal ear. For instance, there is still doubt about the way in which the hearing is improved when the labyrinth is fistulized—whether the sound waves go directly through the fistula and give impulses to the perilymph or whether they still go through the drum, the cavity of the middle ear and the round window, with the fistula acting only to mobilize the perilymph.

Further experiences with this surgical treatment of progressive deafness will aid in solving the problems associated with it. Cases

in which the procedure is successful will establish it more firmly as an important therapeutic advancement, and those in which it fails should only emphasize the great importance of proper selection of patients and accurate surgical technic

SUMMARY

Permanent improvement of hearing in cases of chronic progressive deafness by fistulization of the labyrinth depends on the maintenance of the fistula by the prevention of bony regeneration of the labyrinthine wall

Closure of the fistula can be prevented by adherence to an exacting surgical technic

To obtain the desired improvement the cases for operation must be selected with great care. Bone conduction must be good, the vestibular function must be normal, and the tympanic membrane must be in good condition

A report is made of 8 cases in which labyrinthine fistulization was performed according to the technic described by Lempert

In 4 of these cases considerable improvement of hearing is revealed by audiometric examination. In 2 cases the hearing in the ear operated on has been made worse, partly because of faulty operative technic and partly because the type of deafness was not suitable for improvement by this procedure. In the remaining 2 cases there is little or no change in the hearing

Possible dangers of the operation are mentioned and postoperative reactions and complications discussed

END RESULTS OF INTRANASAL OPERATION FOR MAXILLARY SINUSITIS

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Surgical treatment of chronic maxillary sinusitis may be either radical or conservative, definite and rigid rules cannot be laid down, for treatment must be suited to the individual patient. There are patients for whom only a radical operation will suffice, but usually, conservative measures will restore the antrum to a normal state.

To determine the type of operation to be used, a careful preoperative study of the maxillary sinus should be made. This examination is not complete without the use of an antroscope. By means of this instrument, the presence of polyps, cysts and tumors, as well as the condition of the lining mucous membrane, often can be determined.

To estimate the benefits derived from the conservative treatment of chronic maxillary sinusitis, I¹ studied in 1927 the histories of 385 patients so treated. An effort was made to determine the causative background and thereby to ascertain whether certain types of disease of the antrum would respond to conservative methods. Most of the patients could not give the date of the onset of symptoms, nor did they know whether their symptoms accompanied a cold in the head. Many were able to trace the infection in the antrum to a diseased tooth or to its extraction. In 22.5 per cent of the cases, the infection clearly followed extraction of abscessed molars. In 63 cases, a fistula extended through the alveolar process and into the antrum.

Antral infection of dental origin was usually marked by several characteristics: (1) The infection was confined to the antrum and was unilateral, (2) the upper sinuses were not involved, (3) the pus was foul smelling and similar to that associated with infection caused by the colon bacillus, (4) polyps had not formed, and (5) healing was unusually rapid after institution of suitable drainage and ventilation. In all the cases the infection in the antrum cleared, and in many the

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This and the following papers were read as part of a Symposium on Final Results of Operations for Chronic Suppurative Paranasal Sinusitis at the Forty-Fifth Annual Meeting of the American Laryngological, Rhinological and Otological Society, Inc., Chicago, May 10, 1939.

1 Hempstead, B. E. Intranasal Surgical Treatment of Chronic Maxillary Sinusitis, *Arch Otolaryng* 6:426-430 (Nov) 1927.

alveolar fistula closed, after curettement. In the other cases, it was necessary to close the fistula by utilization of some form of flap. All fistulas eventually were closed.

A review of the 385 cases shows that it was necessary to do a Caldwell-Luc operation in 2 cases. In both cases the antrum was filled with polyps. In 2 cases, osteomyelitis of the maxilla followed, 1 patient died, and 1 recovered. The condition of the patient who died was complicated by severe bilateral bronchiectasis and marked inanition. Stenosis of the tear duct associated with epiphoria was seen in 3 cases. In 4 cases, membranous closure of the window occurred, and a second operation was necessary.

In 1921, Barlow² reported the results of intranasal operation in the treatment of maxillary sinusitis in 100 cases. A modification of the Mikulicz operation was used in all cases. Forty-seven per cent of the patients were cured. Six per cent were finally operated on radically. Seventeen per cent were not improved, and 36 per cent were improved but not cured.

In 1922, Lyons³ reported a study of 100 cases of empyema of the antrum of Highmore occurring after extraction of teeth. The modified Mikulicz operation was used for all patients but 1, for whom the Denker operation was used.

Goodyear⁴ in 1934 reported a series of 84 cases in which he had done the intranasal operation. He had previously been an advocate of the Caldwell-Luc type of operation, but after a trial of the intranasal method he stated, "my experience convinces me that in many cases the end-results in a properly performed intranasal operation are equal and even superior to those obtained by the more radical approach through the canine fossa." He stressed the point that not only should the window be brought well forward and downward but it should be carried as far posteriorly as possible. This last procedure is avoided by most operators because of fear of injury to a branch of the sphenopalatine artery. This accident occurred only once in his series of operations. In my experience, injury of this blood vessel has been a most troublesome complication and has necessitated ligation of the external carotid artery. Goodyear also advised firm packing of the antrum with gauze impregnated with 5 per cent iodoform powder.

2 Barlow, R. A. The Value of Conservative Intranasal Drainage for Chronic Empyema of the Antrum, *Minnesota Med* 4 445 (July) 1921.

3 Lyons, H. R. Empyema of the Antrum of Highmore Secondary to Extraction of Teeth. A Study of One Hundred Cases, *J. A. M. A* 78 486-487 (Feb. 18) 1922.

4 Goodyear, H. M. Chronic Antrum Infection. Treatment by Intranasal Antrum Operation and Packing, *Clinical and Experimental Results*, *Arch. Otolaryng* 20 542-548 (Oct.) 1934.

In this series of operations, secondary enlargement of the opening was done in 6 instances, and in 1 case it was necessary to operate three times

Tucker⁵ called attention to the occurrence of the major part of the pathologic change common to sinus disease in the mucous membrane. He stated the belief that conservative measures should be employed. In a series of 673 patients having chronic maxillary sinusitis who were operated on by the intranasal method, it was necessary to do a Caldwell-Luc or some other type of radical operation for 6. In 47 cases in this series, or 7 per cent, the condition was of dental origin. It is interesting to note that in 9 cases in which polyp could be seen in the sinuses at operation, the polyp could not be seen later. It seems to me that this observation is proof that drainage and ventilation permit the diseased membrane to return to normal and that its exenteration is not always necessary.

Stevenson⁶ in an excellent article reported 192 cases of chronic maxillary sinusitis. He came to the conclusion that intranasal surgical treatment is the method of choice for primary attack in all cases of chronic antral infection. Ninety-four and two-tenths per cent of his patients recovered completely after this procedure.

Williams⁷ in an excellent paper in 1935 gave credit for the intranasal approach to Mikulicz, who described the operation in 1886. It was later modified by Krause. The method now used is a modification of Krause's operation. Williams presented a review of the literature and reported the end results obtained for 200 patients having chronic maxillary sinusitis treated at the Mayo Clinic in 1926. He felt that sufficient time had elapsed to judge whether the good results obtained might be permanent. Surgical approach by way of the inferior meatus was the treatment for all the patients.

Williams divided the 200 patients into two groups. In one group, of 123, he had to depend on questionnaires. In the other group, of 77, he had the opportunity of examining and determining the results of the operation. For 11 patients of the latter group, results were not satisfactory. For 5 of these 11 patients, enlargement of the window produced a perfect result. Another patient obtained a clinical cure but subjectively was not relieved. There was 1 failure in a case of bilateral

5 Tucker, J. C. Conservative Surgical Treatment of Chronic Maxillary Sinusitis, *Ann Otol, Rhin & Laryng* **37** 631-633 (June) 1928

6 Stevenson, W. Chronic Maxillary Sinusitis. An Analysis of One Hundred and Ninety-Two Cases That Came to Operation, *Arch Otolaryng* **13** 506-531 (April) 1931

7 Williams, H. L. Intranasal Operation for Chronic Maxillary Sinusitis. End Results in Two Hundred Cases in Which the Principles of Kuster Were Employed. *J. A. M. A* **105** 96-100 (July 13) 1935

bronchiectasis One patient's infected frontal sinus had been overlooked When this had been treated, a cure was obtained One patient suffered from intranasal bleeding after operation, which necessitated packing An ethmosphenoid infection occurred, but with appropriate treatment a cure was obtained For 2 other patients a Caldwell-Luc operation had been advised elsewhere, but institution of dry suction and abandonment of daily lavage resulted in a cure Eventually, 92.3 per cent of patients within this group were cured of their afflictions

Of the group of 123 patients not seen after operation, 104 reported that they had experienced no return of their former symptoms Four of the 19 patients who reported unsatisfactory results were undoubtedly, and 1 probably, allergic Two had severe bronchiectasis The poor end result for another was the result of undiagnosed frontal sinusitis A poor result was obtained for 1 patient who had severe diabetes associated with ozena One patient who had a large choanal polyp was not cured Severe osteomyelitis was the cause of another failure For 2 patients, failure of the surgeon to close an alveolar fistula was the cause of a poor result For another patient complete relief was obtained after a Caldwell-Luc operation had been performed and for another after operation on the opposite side Four patients reported poor results, no cause for the failure of operation could be determined

SUMMARY

Two things should be considered in the treatment of every patient having maxillary sinusitis first, cessation of discharge and, second, restoration of the antral mucous membrane to as nearly normal a condition as is possible Unnecessary destruction of the ciliated epithelium should be avoided A functioning mucous membrane is to be preferred to scar tissue

A careful preoperative study should be made to rule out the presence of a dentigerous cyst or of a granuloma arising from an infected tooth A recent study of a series of cases with Dr Austin, of the dental department of the Mayo Clinic, has convinced me of the necessity of cooperation between the rhinologist and the dentist in conditions that affect the maxillary sinus

The presence of allergy calls for special treatment The infection should be cleared up, but a dry antrum cannot be obtained until the allergic condition has been brought under control

The presence or absence of infection in the upper sinuses should be determined The antrum may be merely acting as a reservoir, if such is the case, draining it alone would not cure the infection

Postoperative care is of the greatest importance Many poor results are directly caused by inadequate treatment My colleagues and I, of

the Mayo Clinic, prefer to use dry suction and completely to avoid lavage with aqueous solutions. The patient should be seen daily, the contents of the antrum should be aspirated, and the suction tip should be moved freely in the window to maintain its patency. The patient should not be dismissed from treatment until the antrum is dry. The antroscope should be used for patients whose convalescence is slow.

CONCLUSIONS

1 The intranasal window operation is easily and quickly accomplished, with the patient under local anesthesia.

2 Turbinate tissue is not lost when it is performed.

3 Reaction to it is much less severe than that following the radical operation.

4 It causes a minimal amount of injury to the lining membrane, which is permitted to return to as nearly normal function as is possible.

5 Polypoid and badly infected membranes have been seen to return to normal after drainage and ventilation have been established.

6 Use of the antroscope is a great aid in determining the necessity of conservative or radical measures.

7 The high percentage of good results obtained with this operation justifies its use in the treatment of certain patients having chronic maxillary sinusitis.

8 Closure of the alveolar fistula is necessary if a good result is to be obtained.

9 This type of operation is not suitable for antrums having partitions and dense antionasal walls.

10 This type of operation is not suitable when antrums contain foreign bodies or for an antrum in which the presence of a tumor is suspected.

In this report 1,634 cases are gathered from the literature. A good result was obtained in 97 per cent of these cases by the intranasal antial window.

END RESULTS OF INTRANASAL OPERATIONS ON THE ETHMOID, FRONTAL AND SPHENOID SINUSES

E R FAULKNER, M D †

NEW YORK

The estimate of the end results of any surgical procedure must be somewhat relative. The experience of many operators, however, when properly correlated, may justify some definite conclusions in establishing the value of an operation in the light of its final results.

One must always be careful in the selection of such data if one is to arrive at reliable results. The experience of some is often found to be untrustworthy for various reasons. The old maxim that experience teaches fools is not the truth but rather the opposite, that only the wise profit by experience.

One may almost postulate at the outset in discussing this subject that the results of intranasal operations on the sinus vary directly with the skill and training of the operator. It is, as every one knows, a difficult surgical field, and perhaps nowhere in the body is it more necessary for a surgeon to develop the sense which the late Dr. Osler called "eyes in your fingers." This clinical sense can be developed only in those who have a thorough knowledge of the anatomy of the region and have had in addition a long experience in operations on cadavers. One must also know definitely the various pathologic processes and be able to judge accurately the pathologic conditions which are amenable to operation. For example, a type of infection of the ethmoid sinuses producing slowly obliterating osteitis with resultant atrophic changes in the membrane presents a condition for which intranasal operation can offer no prospect of cure. On the other hand, the suppurative hyperplastic and polypoid forms can be successfully relieved or cured by an intranasal operation. Of late a little tendency to disapprove of all forms of intranasal operation on the sinuses has been propagated among the laity and in some cases among various groups in the medical profession. Such opinions are not war-

† Dr. Faulkner died on May 29, 1939.

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wanted but have found some reason for their existence in the bad results observed from imperfect and incomplete operations

The persistent tinkering in the removal of polypi and in the partial ethmoidectomies that have come under my own observation easily explains the wrong impression which has prevailed, and I should like to emphasize my conviction that there is about the same justification for partial ethmoidectomy as there is for partial mastoidectomy, even granting the possibility of only part of the area being involved. When the cells are only partly exenterated one has established a certain road for infection to those remaining, and even if that were not so, one has left an irregular ragged surface of half-opened cells which can never heal. Some will become closed with scar tissue and be certain to give subsequent trouble.

I should like to report a case briefly to illustrate that

About fifteen years ago a woman came to New York to consult the best oculist in that city. She had had a condition which had seriously damaged her left eye, so much so that she had no vision left. She came with a history of having had an ethmoidectomy.

Finally she fell into the hands of an oculist who could not find any other possible cause, so he sent the patient to me to have the sinuses reexamined. I found that the whole posterior ridge of the ethmoid sinuses on the left side, as well as the sphenoid sinus, was much diseased. There was only a mass of granulation tissue and pus there, the most obvious focus ever seen. I could see it without the pharyngoscope or anything else. I advised immediate operation, cleaned it out as thoroughly as I could and opened the sphenoid sinus. The visual acuity was restored to 20/40, which had been considered hopeless.

The exponents of the external operation may say that all intranasal operations are incomplete. That is so in a good many cases, but from a long experience on the cadaver I can state that in the great majority of cases cells can be sufficiently removed to give adequate drainage to the few that are left. In all dissections of cadavers my colleagues and I used to split the head after the intranasal operation on the ethmoid sinuses, and in nearly all cases we found some drains in the cells that were there. The exception to this is a type of shallow anterior ethmoid cell extending out over the roof of the orbit. This cell is often missed in the external operation as well, a fact which I have proved by a good many secondary external operations.

Let me now consider more specifically the results of surgical efforts in the frontal, ethmoid and sphenoid sinuses. The intranasal operation on the frontal sinus has always one purpose, viz., to enlarge the nasofrontal duct to provide better drainage and enable one to carry out intranasal treatment. Attempts are made sometimes to treat this sinus alone by removing the anterior end of the middle turbinate and a few anterior ethmoid cells, a rasp being inserted and the passage

enlarged forward. I confess that I have never found this a satisfactory procedure and have almost abandoned it. The ethmoid sinuses are practically always involved with the frontal, so I prefer to do an ethmoidectomy and have the frontal opening undisturbed. I always pass an applicator or a cannula through the natural opening into the frontal sinus and find it stays open provided I have all the cells removed behind the nasal process. Subsequent treatment can then be carried out, and unless there is complete degeneration of the frontal mucous membrane a satisfactory recovery follows.

Let us now consider the various types of pathologic change in the ethmoid and sphenoid sinuses amenable to operation. Suppuration in this area in the acute stages rarely calls for surgical treatment unless there is a rupture into the orbit and in that case it should be treated by an external operation. In cases of chronic steady purulent discharge satisfactory surgical results follow, but a great deal of after-attention is required. A discharging frontal sinus may keep the area of the wound continually infected, and until it is cleared up healing will be unsatisfactory. One may frequently find it necessary to remove exuberant granulations, and unless the suppuration in the frontal sinus can be controlled the end result will not be satisfactory. I can remember only 1 instance in which I finally had to do an external operation on the frontal sinus to clean up the discharge.

The next type of pathologic condition to consider in the ethmoid sinuses is the hyperplastic form. In many cases it is secondary to a low grade infection and is not necessarily allergic. This is the type most often associated with disease of the eye, optic neuritis or some of the inflammatory changes in the choroid and iris. In the cases of optic neuritis operation as soon as possible is imperative. I should like to urge this necessity on all my oculist friends. I have seen in the past year the tragedy of loss of vision due to neglect in 2 young patients. I am certain of the correlation of optic neuritis with posterior sinusitis in many cases and have seen the sad results of delay in making diagnosis, especially in the cases in which both eyes are involved, the patients are shifted about with strong determination to consider the condition multiple sclerosis till it is too late. A week or ten days is as long as they should be left untreated, though occasionally one may make a fair recovery even after a month.

The intranasal operation on the ethmoid and sphenoid sinuses is the procedure of choice, and there is not a more spectacular result in the whole field of surgery than can be obtained in these cases if the patient is taken in time. In cases of recurring iritis or iridocyclitis also satisfactory results are attained when the focus of infection is located in the ethmoid or sphenoid sinuses.

I shall now consider the largest group of conditions amenable to operation, viz, those with polypoid degeneration. They are the ones with which most of the tinkering operations are done, and many of the patients have a session with a specialist about every three months. The intranasal operation must be done thoroughly, and then vigilance must be maintained for some time afterward, if this is done there is slight chance of recurrence. Once the area is covered with epithelium there will be little prospect of any further trouble. The patients themselves assume an attitude more or less of defeatism. Some doctors perhaps encourage them in doing that, but I have found them one of the most satisfactory types for intranasal operation.

A good many years ago a man came to New York, very much an invalid, supposed to have bronchiectasis. He was a farmer upstate and had practically had to give up his work. As a young man, 39 years of age, he almost resigned himself to a life of invalidism. His nose was literally filled with polypi. He could not breathe. Both antrums were full.

I made two sections, as I always do in such cases—I do a submucous ethmoidectomy, open the sphenoid sinuses and give them a little respite and do the double radical antrectomy at the next session. The patient made an excellent recovery, is practically well and has been able to do his work ever since.

I remember one time he was looking rather pensive, and I asked him what he was thinking about. He said, "I was thinking about the thirty-nine operations I had before I ever saw you."

In following the records of patients after intranasal operations one must consider the final results from a local and from a general perspective. The local effect will be a good breathing nose and comparative though not entire freedom from discharge. There will usually be some mucoid discharge which does not bother the patient much.

The presence of crusts or scabs afterward is the result of an incomplete operation, especially if the posterior part of the middle turbinate has been left. This interferes with drainage in the sphenoethmoid recess and allows an accumulation of secretion there. The patients are not immune to subsequent acute infections, but such infections are more amenable to treatment and do not last as long. The most troublesome after-result is closing of the sphenoid opening, especially if there is osteitis. This may necessitate a subsequent reopening, but, generally speaking, if it is opened wide enough at the first operation and carefully treated afterward a sufficient opening will be permanent. In cases of sinus headache there is usually some osteitis and the final result is not always satisfactory. This is equally true of the results of more radical operations.

The general results depend on the condition which the operation was intended to cure. In cases of asthma, for instance, antrectomy is usually needed as well, and if the condition is associated with polypoid

degeneration a thorough operation in both regions produces marked improvement in all cases and satisfactory cure in some. The percentage of good results with ocular complications is high. With other lesions due to focal infection in the sinuses, such as arthritis the results have not in my experience been satisfactory. The patients often show marked improvement for a time, but they are prone to relapse. I have found this to be true even when the most radical sinusal operation has been performed.

A focal infection in the sphenoid sinus is perhaps the most difficult to eradicate, and the surgery of this sinus deserves some special consideration. If the mucous membrane has not degenerated it may be treated by making a large opening in the anterior wall and hoping that resolution may take place by restoration of the membrane to normal function. If pathologic changes render it necessary to remove the membrane one is left with a cavity which must heal by granulations filling it or by epithelium covering a granulating surface on its walls. In the first instance, it usually becomes constantly infected with continuous discharge from broken-down granulations, and the process may go on for years. In order to offer much prospect of success one must take off as much of the anterior wall as possible and a good portion of the floor. In the second method of healing also the process will be greatly accelerated by the same radical removal of the anterior wall and the floor. In several instances I have seen adhesions between the floor of the sella and the sinusal floor shut off a small cavity in the posterior part, which has always produced serious symptoms, so it would seem advisable in all cases of sphenoid sinusitis in which the membrane has been removed to do a fairly radical operation to facilitate healing and to prevent the occurrence of subsequent untoward results. This operation can be performed by the intranasal route as thoroughly as by the external.

In this brief resume I have endeavored to show from my own experience the possibility of lasting benefit from intranasal sinusal operations. I do not consider this the sole method by any means, as many patients can be properly treated only by the external route, but I rather deplore a tendency to advocate the external method as the only one which should be used in operations in this field. I deplore also the tendency to denounce all kinds of operations on the sinuses, for, while this anatomic field is difficult and variable, the many excellent results obtained may compare favorably with the benefits from operations in any region of the body.

END RESULTS OF EXTERNAL OPERATIONS ON THE MAXILLARY SINUS

SAMUEL SALINGER, M D

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It is generally agreed that ideal surgical intervention consists of the adequate removal of a diseased focus with the least possible trauma to adjacent structures and with a minimum sacrifice of vital functioning tissue. It follows, therefore, that the more radical the procedure necessary for the accomplishment of the first objective the more difficult it becomes to attain the other two. Having these facts in mind one can realize how important it is to appraise the situation thoroughly in a given case before resorting to so-called radical surgical intervention.

Applying this logic specifically to the maxillary sinus and with a full realization of its implications, I have no hesitancy in stating that the Caldwell-Luc operation is the most satisfactory surgical procedure about the nasal accessory sinuses and the one which should yield the highest percentage of good results in conformity with the principles set forth at the beginning of this paper. This statement is based on the following facts. First, the technic is simple and easily carried out, second, the entire sinus is open to inspection, so that there can be no excuse for overlooking any pathologic tissue, third, complications and sequelae are rare, and, fourth, nasal function is in no way impaired.

Omitting from the present discussion the consideration of tumors, foreign bodies and fractures of the sinus as indications for the operation, one must confine one's studies to the pathologic processes affecting the lining membrane of the sinus, since a great deal depends on an accurate appraisal of the degree and extent of these processes. In addition, one's conclusions as to the effectiveness of this operation must be based on the relation of the local findings to the symptoms, a consideration of the patient as a whole and a determination of the degree of care and skill with which previous conservative treatment has been applied. Some of these factors have been thoroughly elaborated by Wherry,¹ Mithoefer² and others, so that it is superfluous for me to

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1 Wherry, W P. The Nasal Accessory Sinuses as a Focus of Infection. Evaluation of Various Diagnostic Methods, *Tr Am Laryng, Rhin & Otol Soc* 41 71, 1935

2 Mithoefer, W. Non-Operative Treatment of Nasal Sinus Disease, *Surg, Gynec & Obst* 60 587 (Feb, no 24) 1935

dwell on them at any length. The points on which I desire to lay the most emphasis in this paper are the diagnosis of the pathologic process, the importance of properly assessing the local complicating factors and the operation itself. But before going into detail on these items let me make it clear that I never advise a Caldwell-Luc operation unless I am satisfied that there exists within the antrum a degree of pathologic change which is beyond the hope of repair by any means short of complete removal and that the pathologic change so diagnosed is the cause of the symptoms for which the patient is seeking relief. These are the premises on which I base my indications.

Roughly speaking, the pathologic changes to which I refer may be divided into two groups: the one associated with various degrees of local symptoms of which the patient is aware and the second more or less silent or occult but associated with manifestations of disorders elsewhere in the body. The diagnosis of the former is usually simple. The most frequent symptoms are nasal discharge, obstruction to breathing, headaches and frequent colds. Usually there is a history of repeated attacks of coryza with or without acute sinus pain. The patient may have undergone various minor procedures, such as antial lavage, tamponade, removal of polyp and other intranasal operations, and the process has manifested cycles of comparative relief between attacks, according to the weather and the general status of the patient's health. Examination during an attack reveals a purulent or mucopurulent discharge, with or without polyp, thickened, red lateral pharyngeal bands, cloudiness of the antrums, usually more marked on one side, and marked obscurity of the shadow on a roentgenogram. Between attacks the findings may vary from comparative normalcy within the nasal passages to the presence of mucopurulent discharge, polyp and a red or glazed pharynx. In any event, regardless of the gross appearance, one finding is constant, namely, a persisting cloudiness of the antrum on transillumination or a definite obscurity of the normal sinus outlines on a roentgenogram or both. Even though irrigation may yield little or no secretion, when one considers the past history of the patient in connection with the roentgen findings the conclusion that the lining membrane of the sinus is not normal is inescapable. The last and most convincing means of diagnosis is the roentgenogram taken with a contrast medium in the sinus. Although some rhinologists claim to be able to determine the contour of the lining membrane by flat plates alone, I myself feel much more confident when I can see the outlines as they are sharply delineated by the introduction of iodized poppyseed oil. Whether the procedure is carried out by puncture through the inferior meatus, by direct cannulation or by displacement is of secondary importance. The consideration that carries the greatest weight with me is the appearance

of a thickened, irregular membrane at a time when the patient has the fewest subjective symptoms and a minimum of objective findings. In other words, if the sinus looks bad when the patient feels best, there can be no doubt that a chronic unresolved process is present which will yield to nothing less than radical extirpation.

As to the second group, namely, that in which the patient's local manifestations of sinus disease have been minimal but he is suffering from ailments suggesting a focus of infection, one has to weigh various factors carefully before definitely concluding that the sinus is at fault. The ailments to which I refer are chronic bronchitis, asthma, bronchiectasis, arthritis and neuritis. These conditions and, less frequently, others have been associated with chronic maxillary sinusitis to a greater or less degree. The question as to whether the latter is always the etiologic factor in the former, whether the two conditions have developed simultaneously or whether the sinusitis is purely coincidental has been thrashed out in the literature over a number of years. Time and space will not permit a thorough analysis of the many valuable contributions on this subject. Those who are interested will find them all abstracted in the reviews of the literature in the *Archives of Otolaryngology* for the past five years. Nevertheless, a brief summary may help to clarify the situation as it stands.

That infection may be transmitted via the lymphatics and the venous system from the antrum to the lower air passages as well as by direct aspiration has been proved experimentally by Mullin and Ryder³ and Larsell⁴ with the collaboration of Fenton and confirmed by others. Second, that in many cases chronic bronchitis, bronchiectasis or asthma, which defied other therapeutic measures, has cleared up or been largely ameliorated after radical operation on the sinuses has been attested by Clerf,⁵ Cooke and Grove,⁶ Manges,⁷ Hodge,⁸ Kartagener and Ulrich,⁹

3 Mullin, W. V., and Ryder, C. T. Studies of the Lymph Drainage of the Accessory Sinuses, *Laryngoscope* **31** 158 (March) 1921.

4 Larsell, O. Lymphatic Pathways from the Nose. Research Report, *Arch Otolaryng* **24** 696 (Dec.) 1936.

5 Clerf, L. H. The Interrelationship of Sinus Disease and Bronchiectasis, with Especial Reference to Prognosis, *Laryngoscope* **44** 568 (July) 1934.

6 Cooke, R. A., and Grove, R. C. Relation of Asthma to Sinusitis, with Special Reference to Results from Surgical Treatment, *Arch Int Med* **56**, 779 (Oct.) 1935.

7 Manges, W. F. Accessory Sinus Infection. Its Relationship to Mastoid and Lung Infections, *Ann Int Med* **9** 547 (Nov.) 1935.

8 Hodge, G. E. Relation of Bronchiectasis to Infection of the Paranasal Sinuses, *Arch Otolaryng* **22** 537 (Nov.) 1935.

9 Kartagener, M., and Ulrich, K. Zur Pathogenese der Bronchiektasien. *Bronchiektasien und Veränderungen der Nasennebenhöhlen*, *Beitr z Klin d Tuberk* **86** 349, 1935.

Kelley,¹⁰ Harbert,¹¹ Watkins,¹² Davison,¹³ Walsh and Meyer¹⁴ and others. Certainly enough evidence has been forthcoming to prove the close relation in a large percentage of cases. When failures have resulted after operation on the sinuses the fault has been with the surgeon in neglecting to investigate the individual patient thoroughly enough. An analysis such as was made by Goodale¹⁵ reveals many sources of error which only careful study can eliminate. Harbert¹¹ adequately summarized the subject when he said that differences in reports on asthma were due to

(a) absence of controls in reporting cases, (b) differences in criteria of diagnosis and standards of cures, (c) generalization from too few cases, (d) observation over too limited a period of time, (e) failure to properly evaluate factors such as allergy

That seems to sum up the case pretty thoroughly

With reference to arthritis, neuritis and other painful conditions suggesting a focus of infection, the evidence as to cause and effect is less convincing than in connection with bronchial infections. While post hoc, ergo propter hoc testimony has been offered by some excellent observers, scientific or experimental proof is still scanty. Nevertheless focal infection has been accepted by most physicians and proved at least clinically in many excellent theses. However, as applied to the maxillary sinus the subject is still a matter of conjecture. The only rational way to evaluate the role of the maxillary sinus in these conditions, as well as in the bronchial conditions, is to determine whether the sinus is normal and if it is found to be abnormal just what degree of change is present. Also, it is highly important that the history of the development of all the symptoms be thoroughly studied since time bears great weight. The situation here is not as simple as in the case of a suspected tooth or tonsil, the removal of which on slender evidence may be justifiable in an effort to eradicate every possible source of infection. One cannot honestly advise a radical operation on the antrum on the basis of a mere suspicion of slight cloudiness or haziness in a

10 Kelley, S. F. The Incidence of Sinusitis and Nasal Polypi in Bronchial Asthma, *Laryngoscope* **46** 692 (Sept.) 1936

11 Harbert, F. A Review of the Relation Between Sinusitis and Pulmonary Disease, *U. S. Nav. M. Bull.* **34** 52 (Jan.) 1936

12 Watkins, A. B. K. Oto-Rhino-Laryngological Considerations in Bronchiectasis, *M. J. Australia* **2** 118 (July 25) 1936

13 Davison, F. W. Chronic Sinusitis. Its Relation to Chronic Bronchitis, *Pennsylvania M. J.* **40** 821 (July) 1937

14 Walsh, F. W., and Meyer, O. O. Coexistence of Bronchiectasis and Sinusitis, *Arch. Int. Med.* **61** 890 (June) 1938

15 Goodale, R. L. An Analysis of Seventy-Five Cases of Bronchiectasis from the Viewpoint of Sinus Infection, *Ann. Otol., Rhin. & Laryng.* **47** 347 (June) 1938

roentgenogram How should one then be guided? When the history reveals a previous sinusal infection of sufficient degree to have necessitated more or less therapy and one which impressed itself on the patient in spite of a long symptomless interval, one may seriously hold the sinus accountable for the constitutional condition for which he seeks relief. This is particularly true when roentgenograms reveal a lining mucosa that definitely exceeds the normal in thickness. Semenov¹⁶ in his excellent work on the surgical pathology of the sinuses has shown that "thickening in excess of 2 mm is associated with deep seated degenerative changes in 50 per cent of the cases" And when, in addition, cultures from aspirated irrigating fluid yield bacteria that are particularly pathogenic when injected into experimental animals, one may feel even

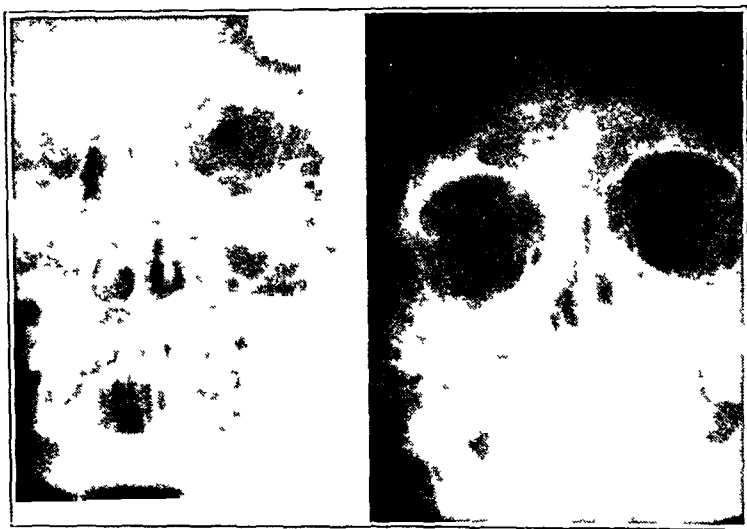


Fig 1—Roentgenogram of a man aged 25 with bilateral pansinusitis with polyps and pus. A bilateral Caldwell-Luc operation with transantral exenteration of the sphenoid and ethmoid sinuses and intranasal operation on the frontal sinus was performed.

more certain that the sinus is the seat of a chronic infection which is more than likely the focus sought. Certainly in doubtful cases, especially those in which a clear history of preceding sinusitis is lacking, it should not be too much trouble to carry out this test. Another valuable aid to diagnosis which has perhaps not been employed as much as it should is the measurement of the emptying time of the sinus, as developed by Proetz. When there is considerable delay in the expulsion of the injected contrast medium one is safe in assuming that ciliary activity is below normal, which in itself is definite evidence of disease.

¹⁶ Semenov, H. The Surgical Pathology of Nasal Sinusitis, J. A. M. A 111: 2189 (Dec. 10) 1938.



Fig 2—Specimen from the case illustrated in figure 1, showing edematous and cystic degeneration of the mucosa

The only fly in the ointment in connection with what has thus far been stated is the question of allergy, either as the predominating or as a complicating factor. On this point I fear there is still considerable divergence of opinion. Semenov¹⁶ found manifest allergy in 17 per cent of his cases and equivocal allergy in 35.4 per cent. These findings far from being of negative value to the clinician are, in my opinion, extremely significant. Seventeen per cent is not as large a proportion of definitely allergic mucosae as one might imagine from the stress that has been laid on allergy in general. The majority of these cases could undoubtedly have been eliminated in the beginning by the history, the general status of the nasal mucosa, and the results of cutaneous tests and of examination of the aspirated sinusal fluid. As for the 35.4 per cent labeled instances of equivocal allergy, even if the preoperative diagnosis of specific sensitivity were lacking, one would still be justified in oper-



Fig 3—Roentgenograms of a man aged 32, with chronic postnasal drip, frequent colds and loss of weight. A Caldwell-Luc operation revealed extensive polyposis. A comparison is shown of films made with and without iodized poppy-seed oil.

ating, because the secondary infection had reduced the antial mucosa to a state beyond recovery even had the allergic factors been discovered and removed. This does not imply that the possibility of allergic factors should be ignored. On the contrary, I believe that all rhinologists agree on their importance and make every effort to uncover and eliminate them. The important point is that one must not lay too much stress on allergy, unless it is manifest and unequivocal, to the exclusion of true infection, particularly in dealing with a sinus suspected of being a focus of infection.

Having discussed diagnostic criteria as a basis for the radical operation on the antrum I come now to the operation itself. I stated in the beginning that the procedure was simple and without danger. However, I do not wish to imply that it can be attempted in an indifferent manner

or carried out without due attention to many details, which mean the difference between a prompt recovery and delayed convalescence, with annoying complications and possible sequelae. The points which I like to stress are (1) minimum infiltration of the soft tissues with the anesthetic solution, (2) minimum trauma with retractors, (3) complete removal of all palpably diseased tissue, as well as areas not definitely normal, (4) thorough hemostasis, (5) drainage per rubber tube, and (6) as little postoperative manipulation as possible.

Postoperative edema of the face, in my opinion, is due to one or all of three factors, namely, distention of the tissues by the injected fluid, too much pressure with the retractors and postoperative packing. Since minimizing the first two of these and entirely eliminating the third I

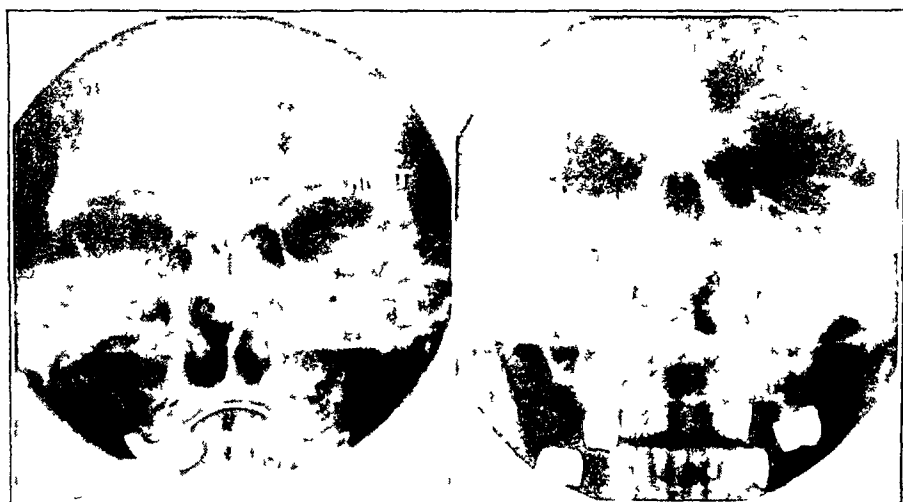


Fig 4—Roentgenograms of a man aged 44 with chronic suppurative of the maxillary and ethmoid sinuses with recurring polyps. Pansinusitis on the right was revealed by a Caldwell-Luc operation, and transantral extirpation of the sphenoid and ethmoid sinuses was carried out.

have had little edema to contend with. In practically all my cases the slight swelling of the cheek which appears within twenty-four hours after operation has completely subsided within three days and has never caused the patient the slightest inconvenience. Complete and adequate anesthesia may be obtained by blocking the posterior dental, infraorbital and posterior palatine nerves. In addition I use cocaine plugs in both the middle and the inferior meatus and inject the line of incision with a 1 per cent solution of procaine hydrochloride. Prolonged pressure with retractors is avoided by removing them at intervals and allowing the soft tissues to resume their normal position. As for postoperative packing, I can see no good reason for its use in the antrum. Packing ordinarily is employed for the control of hemorrhage or to prevent a



Fig 5—Specimen from the case illustrated in figure 4 showing (above) metaplasia of the mucosa and an edematous substrata and (below) cystic degeneration in the mucosa and destruction of the surface epithelium

cavity from collapsing. Neither of these reasons is valid in the operation under consideration. The sources of bleeding in my experience are usually the mucous membrane itself, one of the communicating vessels of the alveolus or a branch of the internal maxillary artery which penetrates the posterior wall of the sinus. The bleeding from the soft tissues is easily controlled by pressure with the hemostat or ligature and the bleeding from the bone by mashing the aperture with a curet or gouge. In any event, if hemostasis is complete at the conclusion of the operation there is little danger of postoperative bleeding. Concerning the question of removal of the sinus lining, I am of the opinion that all macroscopically diseased mucosa, including doubtful areas, should be removed. Membrane that looks soft and red, even though it is thin and



Fig 6—Roentgenograms of a woman aged 49 with asthma. Chronic hyperplasia of the maxillary and ethmoid sinuses was treated by a Caldwell-Luc operation and transantral ethmoidectomy.

fairly well attached to the bone, should be taken out, because it is likely subsequently to undergo the same degenerative changes found in the other, more grossly affected, portions. If one has ever seen normal-looking mucosa in situ one can never forget its pale, almost transparent, glistening appearance. As for drainage, I use a fenestrated rubber tube of maximum diameter, which extends from the posterior wall of the sinus, through the surgical fenestra, up to the anterior nares. If the cheek has any tendency to swell on the day after the operation the tube is removed and not replaced, otherwise, it is left in place for forty-eight hours. Postoperative treatment consists of the application of an ice bag and administration of sedatives if required. When the tube is removed the antrum is aspirated via the inferior meatal fenestra by means of a curved cannula directed toward its floor. Irrigations are employed when

necessary. Occasionally a weak solution of alcohol may be used to remove old clots and counteract odor. As a rule, however, the less irrigation the better. The patient may use an ephedrine spray to relieve swelling of the inferior turbinate, which in some cases is troublesome.

Postoperative sequelae have, in my experience, been rare. I have never seen a postoperative cyst of the cheek, such as is reported numerous times in the foreign literature, nor have I ever encountered lasting anesthesia of the cheek, teeth or lip. The longest that any patient has complained of this symptom has been six months. In most cases the primary numbness wears off within two to three weeks. Occasionally

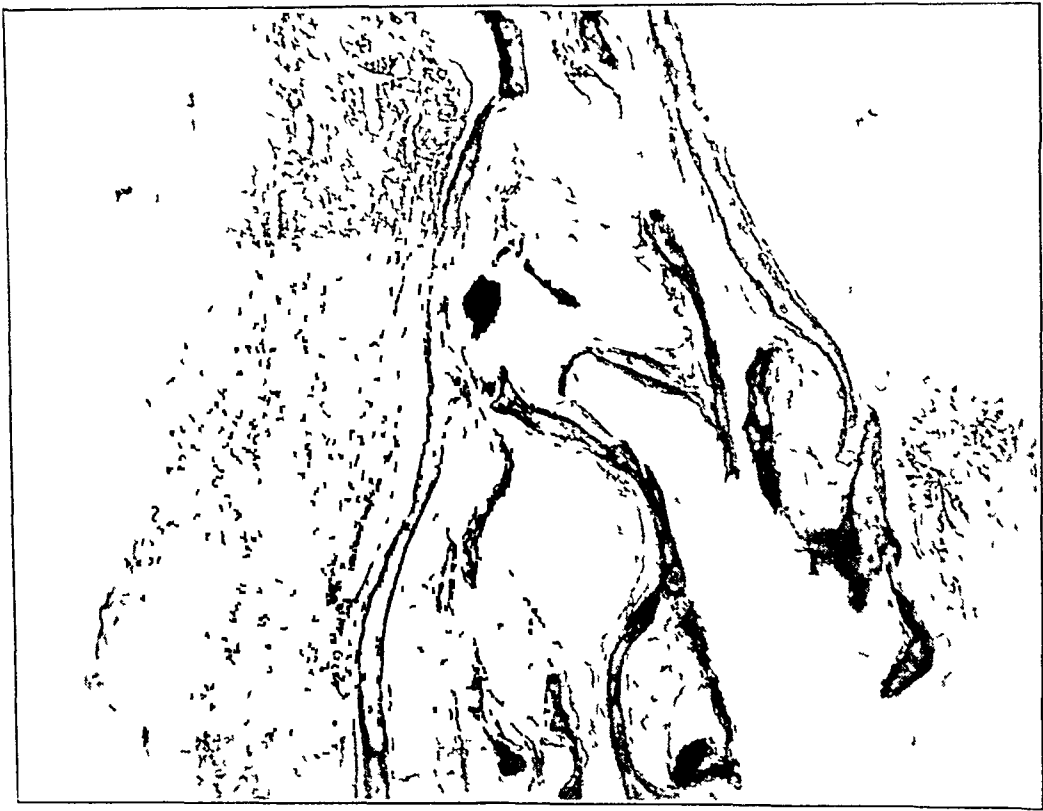


Fig 7—Specimen from the case illustrated in figure 6, showing destruction of epithelium, periostitis and cystic degeneration

the gingival incision tends to remain open, but in such instances I have found the cause to be inadequate intranasal drainage, due to swelling around the fenestria. In no instance, however, did the opening fail to close spontaneously after appropriate local treatment was instituted.

As to complicating factors at the time of operation, the one most frequently encountered is coexisting chronic ethmoid, sphenoid or frontal sinusitis requiring surgical intervention. My procedure in such cases is to follow the Caldwell-Luc operation with transantral exenteration of the ethmoid and sphenoid sinuses, which is easily carried out. The anterior cells, however, must be reached intranasally. The entire naso-

antral wall of the middle meatus is removed a wide passage being thus provided from the operative field into the nasal cavity. If the middle turbinate is hyperplastic or tends to obstruct drainage it is removed in part or completely as the case may be. In such cases, the opening in the inferior meatus is omitted, and the rubber tube introduced into the antrum is pulled through the enlarged middle meatus into the nasal cavity. Packing is never employed. If the frontal sinus is diseased it is dealt with through a separate external incision.

In looking over several hundred histories from my private files over twenty years of cases in which the diagnosis was chronic maxillary sinusitis I am struck by the ultra conservatism which characterized my treatment in the earlier cases in contrast with the more aggressive attitude of recent years, and I can truthfully say that the latter stand

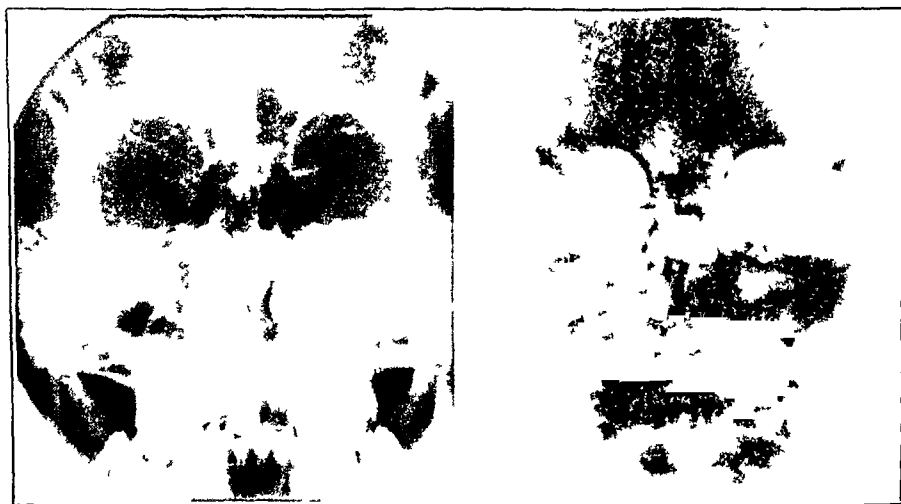


Fig 8—Roentgenograms of a girl aged 17 with a cough and asthma. Injection with iodized poppyseed oil shows thickening of the nasotrantral wall. Thickened polypoid mucosa, chiefly on the nasotrantral wall, was removed by a Caldwell-Luc operation.

has more than justified itself. I could cite any number of instances in which patients returned with recurrence of symptoms year after year despite most careful conservative treatment, and always in such cases my findings revealed the same recurring discharge, the same cloudy appearance on transillumination and the same obscure roentgenograms. It was only when I began studying these cases more carefully, coordinating the history, the findings and the roentgenograms made with the aid of contrast mediums, that I began to appreciate the hopelessness of prolonged and repeated conservative treatment and the necessity for more radical procedures. My results for suppurative conditions, with or without polypi, have been at least 90 per cent perfect. The only instances in

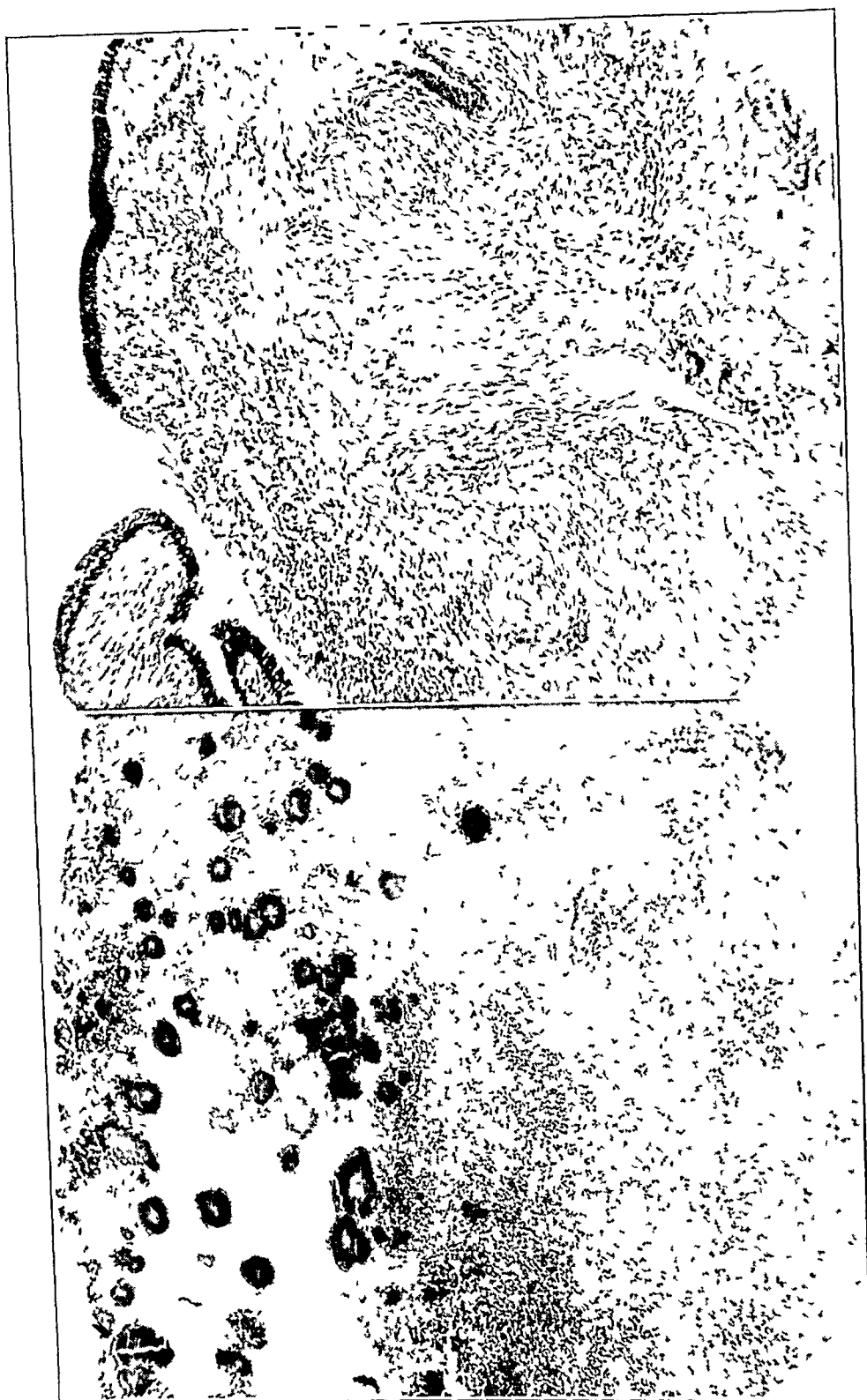


Fig 9—Above, specimen from the case illustrated in figure 8, showing enormous thickening and infiltration of the substrata and loss of mucosa. Below, specimen from a case of chronic maxillary sinusitis with referred pains, chronic cough and loss of weight, showing loss of epithelium, massive infiltration and areas of necrosis.



Fig 10—Specimen from a case of chronic sinusitis in which a previous incomplete operation had been performed, showing (above) chronic inflammatory changes with fibrosis and (below) thickened mucosa and polypoid formations

which polypoid discharge has reappeared were those in which coexisting ethmoiditis was inadequately treated. My results for chronic bronchitis, asthma and other nonspecific pulmonary conditions have been as good as those of the authors I have quoted, although the actual number of cases is not large enough to constitute an impressive statistical study. Nevertheless, I can state most emphatically that I have never been disappointed in the operation when my preoperative diagnosis was based on sound facts and careful study and when possible allergic factors had been thoroughly investigated and taken care of.

In conclusion I say again that the radical operation on the antrum has in my hands proved to be the most uniformly successful and satisfactory operation of the entire nasal repertoire and that success in its application depends on the scrupulous care with which the local process is studied and the relation to constitutional factors appraised, the degree of skill applied in its performance and the attention that is paid to disease in the other sinuses.

END RESULTS OF EXTERNAL OPERATIONS ON THE FRONTAL, ETHMOID AND SPHENOID SINUSES

M F ARBUCKLE, M D
ST LOUIS

In arranging this symposium the president, Dr Lillie, expressed a desire to have presented at this meeting a thorough review which would cover as completely as possible the results obtained by operations on the various sinuses. The subject of "External Operations on the Frontal, Ethmoid and Sphenoid Sinuses" was assigned to me.

The task of checking up on the cases has been much greater than anticipated, and I am afraid that I have not been able to examine the records in anything like all the cases available, even in my own practice. I find that from 1921 to 1939 I have operated for sinus disease in approximately 600 cases in the Barnes Hospital alone. During this study I have been able to check up on a sufficient number of cases to gain adequate and most interesting information. One of the most interesting facts brought forth in this study is the tremendous decrease in the number of operations on the sinuses. This is undoubtedly the direct result of increased knowledge of the manifestations of allergic reactions. The evidence that so-called sinusitis frequently is of allergic origin and sometimes the result of endocrine disturbance is so important and so convincing that I have digressed in order to discuss these features.

Rhinologists have seen the rise of popularity of surgical treatment of sinus disease on the basis that infection was the underlying cause in all cases. During all this time in a certain number of cases relief was not obtained by such treatment. They then found that many such conditions are not of infectious origin but are allergic. Accordingly the popularity of operative treatment has decreased almost to the exclusion of certain types of surgical intervention in favor of antiallergic treatment and, occasionally, endocrine treatment.

A large and rapidly increasing group, of which I am one, feels that allergy is a most important factor in the cause, or one might say is

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Read as part of a Symposium on Final Results of Operations for Chronic Suppurative Paranasal Sinusitis at the Forty-Fifth Annual Meeting of the American Laryngological, Rhinological and Otological Society, Inc., Chicago, May 10, 1939

"the cause," of the complaint in well over half of all persons suffering with symptoms of sinusal disturbance and that when the condition is correctly diagnosed and properly treated operation is contraindicated except when such a person has an infection in his sinus of a type for the relief of which surgical intervention is indicated. Therefore, the necessity of differential diagnosis between infectious sinusitis and allergic sinusitis is obvious.

There is no reason why a person with allergy should not get an infection. Indeed, he is more likely to get a troublesome infection than is one with normal mucosa. When such a person does get an infection which requires surgical drainage, the mere fact that he has allergy should not be allowed to interfere with his getting the proper treatment. Furthermore, I have found that many allergic persons on whom I have operated for the relief of suppurative sinusitis and who have continued to have allergic manifestations from time to time feel that they have been markedly benefited by the operation, because their allergic reactions are not attended with the pain and other disabling symptoms which they formerly had and infections occur less frequently and do not disable them as formerly.

A comparison of the methods of studying sinusal disease now and in the preallergy days is of interest. There is one fact, so well set forth by the example of Greenfield Sluder, which has not been altered, *viz.*, the importance of a thorough knowledge of the anatomy of the sinuses. He was under the impression until late in his life, too late for him to have an opportunity for real work on another basis, that infection was the sole underlying cause of sinusitis. It is now known, of course—and I speak for myself—that many of the clinical entities described by him as of infectious origin in reality are part and parcel of allergic manifestations. Such for example are "vacuum headache," "lower half headache" and "the neck-arm-shoulder syndrome." Roentgen studies of the sinuses were made in his day, to be sure, but differentiation was usually not made between the density caused by thickness of the membrane due to allergy and by that resulting from infection.

In 1922 I made notes in the records of numerous patients in the wards of the St. Louis Children's Hospital in which I described pus recovered from the maxillary sinuses, for example, as either thick and white or varying between green and yellow, with the comment that with the latter a more virulent type of infection seemed to be present but also the patients showed improvement after operation more uniformly than did those from whose sinuses the thick white pus had been recovered in preoperative study. This antedated microscopic study of the cellular composition of the nasal secretions and of the blood for eosinophilia, and I well remember Dr. Hansel's early efforts along this

line and how foolish and useless I thought they were. In my own practice, smears from the nasal secretions are now studied in every case. In addition, blood smears are often made, and the thyroid function is studied, in searching for the cause not only of symptoms referable to the nasal sinuses but of unexplained vertigo and tinnitus. It has been my experience that in hypothyroidism the appearance of the interior of the nose often suggests the condition, and many times a basal metabolism test made because of this symptom alone confirms the diagnosis, although the typical bodily changes usually seen with hypothyroidism, such as increased fat, pallor, dry skin and dry falling hair, are not always present. The blood pressure is likely to be below normal and the free hydrochloric acid in the gastric juice low or absent. The outline of a contrast medium (iodized oil) in the sinuses is likely to be smooth with allergy and irregular or jagged with infection. Cultures may be sterile with allergy but not with infectious sinusitis. The history, of course, is of first importance, and to be dependable it must be taken by the rhinologist himself. Even then the facts needed for a diagnosis may in some cases be elicited with difficulty or not at all, and one may be obliged to go through with tests, even to the point of trial and error and sometimes total exclusion by hospitalizing the patient. A helpful and simple method of study for detecting the unknown cause of headache ascribed by the patient and his doctor to sinusitis is a daily chart of food intake with a record of attacks of headache entered at the time of occurrence.

This may all sound complicated, and at times it is, but I have found that when necessary it pays in the long run. In attempting to differentiate between infection and allergy as a cause of headache, I am convinced, the help obtainable from a specialist in the field of allergy is of the greatest importance to the patient and to the rhinologist. In many cases the cause is so obscure that long and patient search is necessary. Dr C M Stroud, of St Louis, has helped me in a number of such cases, particularly with a group of patients apparently sensitive to molds, for whom the diagnosis was proved by a change of residence and by cutaneous tests.

For drainage of the ethmoid and sphenoid sinuses I do Sluder's operation. It is the safest and most efficacious method of operation on these sinuses that I know of. I feel that it is not possible for me to do intranasal operations on the frontal and maxillary sinuses as satisfactorily as external operations. Surgical intervention on the sinuses is difficult at best. When it is done without visualizing the field on which one is operating one may, with a certain amount of reason, expect poor results. For this reason, I prefer to operate on the sinuses by the external route whenever possible and always when opening the

frontal, maxillary or ethmoid sinuses in cases of osteomyelitis or of orbital abscess. For simple drainage of the ethmoid and sphenoid sinuses, Sluder's operation has proved satisfactory in my hands.

Operations on the frontal or maxillary sinus or the other sinuses, for that matter, in cases of allergic persons should be carried out only after thorough antiallergic treatment, except, of course, when the need for operation is so urgent as not to permit of delay. By this plan a large percentage of patients, who in the past would have been operated on, have responded most satisfactorily to antiallergic treatment, with the result that operation was rendered unnecessary. This has been found to be true in cases in which a few years ago one would have thought by all the rules that operation should be carried out. As a rule when allergic sinuses are operated on symptoms disappear for from six weeks to six months, usually for a period midway between, after which the allergic symptoms recur when the patient is exposed to allergens to which he is sensitive. With this clearly understood there is no reason why operations on the sinuses should not be carried out when indicated.

A few case reports will suffice to bring out some of the points I have in mind.

The first is that of J. F., a man aged 27 when he reported to me for treatment in 1928. His chief complaint was headache and frequent attacks of cold in the head. He had huge sinuses. The diagnosis of sinusitis of the maxillary and frontal sinuses, bilateral, was made. External operations on the frontal and maxillary sinuses were done. The results of the operation were not notably satisfactory, although thickened membrane and pus were removed from the sinuses opened. The patient was acquainted with one of the best known rhinologists in New York, who communicated with me frequently while I was carrying out the treatment. Later he moved back to New York, and because of continued symptoms he was seen by this mutual friend. He was told that the treatment I had given him was all right as far as it went but that it had not gone far enough. Another operation on his frontal sinus was proposed and carried out with similar results. Then the rhinologist died, and when the patient was seen by his successor he was told, according to his story to me recently, that his second series of operations had been inadequate and that he needed further operation, which was carried out with identical results. On Aug. 5, 1938, ten and one-half years after I had first seen the patient, he came into my office, much the worse for wear physically, mentally and financially but with his headache as of old. It was apparent that the external walls of the frontal sinuses, which had been prominent when I had last seen him had been removed in New York, permitting the skin to fall back against the posterior wall of the sinus.

When he returned, his first statement was "Well, here I am back again, still crazy with headache, but I haven't any money with which to pay you." My response was that if he would let me study him there would be no charge. I suspected that headaches were allergic, and my first step was to study smears from his nose. These were loaded with eosinophils. It was plainly evident from his

history that his headache was allergic, and when his nose was examined this opinion was supported by the findings. I showed him how to keep a daily chart of food intake of every sort and how to make entries of the occurrence of the attacks of headache. One month later the patient returned from a trip to the west coast to report to me with great pleasure and satisfaction that the source of his trouble had at last been found. He had discovered by referring back to the chart that every time he ate wheat flour or came in contact with wheat he had an attack of severe headache. On May 4, 1939, his wife called to report to me that if he ate white bread he had an attack of headache and that after they had discovered this and while he was abstaining from wheat flour, he had an attack of headache while passing through a large wheat field in South Dakota. So long as he avoided wheat he was all right.

On the other hand, I wish to report the case of R. M., a man of 22 when I first saw him on May 26, 1925. He had multiple infectious sinusitis and also asthma, with more or less continuous purulent secretions from his ethmoid and sphenoid sinuses. These sinuses were drained by the Studer technic, with the result that his nasal symptoms were and still are remarkably relieved and he has practically quit having headaches or asthma. When he gets an acute cold and his nose is blocked and polyps begin to appear, he is entirely relieved with one or two local treatments and is kept comfortable.

Another case is that of E. H., a woman of 33 when first seen on Sept. 28, 1925, with pansinusitis with infection and allergy. She had terrific headache, and during the attacks she was disabled by the pain and vomiting which accompanied them. She had copious discharge of pus and moderate hypothyroidism. After all her sinuses had been operated on and she had been given thyroid and warned to refrain from taking alcohol and certain articles of diet, she made a satisfactory recovery and is still well so far as headache is concerned. The accompanying photograph demonstrates the lack of deformity from external operations on the frontal sinuses, although deformity is not infrequently a drawback in such operations when the incision is not properly placed.

C. C., a white woman, was 41 when seen July 28, 1926, with bilateral ethmoid, sphenoid and maxillary sinusitis with attacks of headache so extremely severe as to confine her to bed for as long as two weeks at a time, for the relief of which large doses of morphine were inadequate. The sinuses were operated on in 1926 according to the method referred to. I see the patient frequently socially, and she is still free of headache and delighted with the results of her operation.

In over 600 cases of operation, there has been but 1 death, that of a patient who had an abscess of the frontal lobe, which was a direct extension from an infection of the frontal sinus, and in this case the patient's family refused operation for several days, and the patient, when operated on, had been in a coma for three or four days.

There is no reason for any deformity or other unsatisfactory cosmetic result. Medication along the line of endocrine function undoubtedly helps to restore tonus and increase the resistance to infection.

Parenthetically, I should like to remark that I have seen a number of persons who had nasal cavities filled with polypoid tissue in the

early stage of development in whom the polypi have disappeared with antiallergic treatment and remained away until their growth was stimulated by another cold or continued exposure to some allergen. Polypoid tissue which has become fibrotic does not disappear with such treatment.

After reviewing this series of cases, my opinion already formed is borne out, i. e., that differential diagnosis of the cause of sinusitis is necessary before treatment is instituted, that when sinusitis is present



Photograph of patient E. H. after external operation on the frontal sinuses

in an allergic patient treatment along antiallergic lines should be tried before operation, unless the patient has some condition, such, for example, as orbital osteomyelitis, which threatens his life. When operation on the frontal or maxillary sinuses is needed, external operation offers the best opportunity for thorough work and is followed by the most satisfactory results. Many patients who have a combination of infectious and allergic sinusitis require surgical intervention to obtain relief.

DISCUSSION OF PAPERS ON RESULTS OF OPERATION FOR CHRONIC SUPPURATIVE PARANASAL SINUSITIS

DR FRANK J NOVAK JR, Chicago I feel that in handling any chronic antral infection caused by a dental disorder or its treatment, with the production of a fistula, deep, sharp curettage and an immediate flap operation to close the defect are essential

DR ARTHUR W PROETZ, St Louis I am in complete accord with every word that Dr Hempstead has said Dr Faulkner said, "Partial ethmoidectomy is just as unsatisfactory as partial mastoidectomy" To my mind, the two things are not comparable because of the difference in mechanics between the mastoid and the ethmoid In the first place, the ethmoid is supplied with a functioning organ, the ostium, which one is only too prone to regard as a mere hole in the wall It is supplied also with cilia, which not only can function but almost always do, even in badly infected sinuses Dr Barnhill, in his courses, has repeatedly brought out clearly that if a surgeon is allowed to operate to the best of his ability on a cadaver to remove all the cells that he can find and then begins to take the skull apart he will find that he has not got them all, in most cases It is not the leaving behind of those few cells that produces the bad end results, but it is the opening of the skull so wide in looking for them that it can never again take care of itself

The lining of the sphenoid sinus is sparsely supplied with glands The air in the sinus changes only once every hour or so, and it can be kept humid and the cilia kept functioning by the few glands that exist there If the whole of the face of the sphenoid sinus is taken away, including the ostium, it cannot close, try as it will (Goodness knows it wants to close!) If one makes it impossible for it to close, so that a blast of air is continually entering and destroying whatever cilia might tend to regenerate, one has put it in such a condition that it can never take care of itself and there is always a residue of more or less thickened, sticky secretion, made so because the air has access to it That secretion, under those conditions is always a fine culture medium The first breeze that comes along reinfects the sinus, and this happens again and again

DR EUGENE R LEWIS, Los Angeles I think attention should be directed to the patient who has the disease This symposium left me with the impression of a composite picture of most of the materials that I can remember having been presented in these meetings for the last twenty-five years I think the precedent should be carefully relegated to the past, and the members of this society should attempt to devote themselves to something new in its place

DR BURT R SHURLY, Detroit There are some guinea pig hospitals and guinea pig physicians in this country who would do a good thing for themselves by broadening out and becoming more humanitarian, recognizing that the patient is an individual and must be studied from that standpoint

In many hundreds of operations for sinusal diseases, the procedure outlined by Dr Hempstead has been exactly mine

DR WILLIAM L CULBERT, New York It was mentioned that either a part or all of the middle turbinate can be removed, which of course can be, and is, easily done, but I think that the middle turbinate is the center of the physiologic structure of the nose, and sometimes when one sees a patient who has had exenteration of all the sinuses for pansinusitis one discovers that the nose has been exenterated rather than the sinuses

The middle turbinate, I believe, can almost always be saved, no matter what else is being done in the nose

DR SAM E ROBERTS, Kansas City, Mo After one has attended and participated in these meetings for twenty-five years, it is a great satisfaction to see a more conservative view being taken on sinusal disease I defy anybody to do a complete exenteration of the ethmoid sinuses It simply cannot be done, nor can one do a complete mastoidectomy There are certain cells in various places that one cannot reach

DR JOSEPH C BECK, Chicago The pathologic changes of the bone in the sinuses are to be considered first For instance, if one has had a virulent infection to begin with and has had localized thrombotic areas in the bone that will require a long time for exfoliation, how can one expect by removing the membrane to have a healing of the process? There are small tracts underneath, as can be shown by the microscope if not by the naked eye The mucous membrane itself, as Dr Furstenberg showed, has undergone sclerotic changes, both sclerosis of the vessels and thrombosis, which can be seen in the specimens examined There is the secret of the failures, the underlying pathologic changes

DR THOMAS E CARMODY, Denver One does not wish to treat such conditions conservatively or radically but to treat them rationally

DR LEE M HURD, New York To do a good ethmoidectomy, one first must do a subsection of the flaccid septum, so that one can get a diagonal view of the ethmoid area The next step is to take out all the middle turbinate Then one is perfectly safe and can get out most of the ethmoid cells

DR FRENCH K HANSEL, St Louis I should like to emphasize the importance of routine studies of the nasal secretions Just as among children, I feel that many conditions among adults are not recognized as allergic The patients are not typical sneezers They have stuffy noses and hyperplastic changes in the ethmoid, some have polyposis

In many such cases, one finds that controlling the allergy first produces such marked improvement that conservative radical surgical treatment can be used instead of the more radical types

DR JOHN F BARNHILL, Miami Beach, Fla A great deal has been said about allergy I am coming to the conclusion that allergy is secondary and that many of the conditions that are being treated are secondary I am somewhat of the opinion that one must look to the physiologist as well as to the general physician and the surgeon before one will be able to cure all one's patients There are certain patients with sinus disease that will get well of themselves There are certain patients that almost any rhinologist can cure I am convinced that there are a large number that nobody will ever cure There are physiologic, pathologic and anatomic reasons for this

ATRESIA OF THE EXTERNAL AUDITORY MEATUS

CANALIZATION BY ELECTROCOAGULATION

JOEL N. NOVICK, M.D., M.Sc. (M.F.D.)

WASHINGTON, D. C.

Atresia of the external auditory meatus is by no means uncommon. Unfortunately, in some cases it remains unrecognized, while others fail to find their way into the literature.

On the basis of the etiologic factors, atresia is grossly classified as congenital or acquired. The abnormal embryologic events responsible for congenital atresia have been discussed in detail in the splendid work of Lyman Richards.

According to Richards,¹ the outer ear develops in a peculiar manner. It begins as a pitlike indentation of the external cutaneous surface in the region of the future auricle. The pit extends inward for a short distance in the direction of the first gill cleft. From its inner end a solid cord of ectoderm extends inward and becomes expanded medially into a disklike plate, lying on an oblique plane just outside the cavity of the middle ear. The next process is canalization from within outward of the disk, which splits into two layers, tympanic and meatal, the former lying against the ectodermal wall of the middle ear and separated from the latter by a thin layer of mesoderm. This forms the future drum membrane. Canalization continues outward until the intervening cord of ectoderm hollows into a tube and becomes continuous with the pitlike invagination. Deviation from the normal embryologic sequence of events will result in incomplete canalization and atresia of the canal.

Acquired atresia, on the other hand, may result from any of a number of causes, such as chronic purulent otitis media, otitis externa, chronic eczema, trauma to the canal, exostosis and new growths. This type of atresia is probably more prevalent and less complicated than the congenital form.

Diagnosis of atresia of the external auditory meatus is often difficult and is dependent on the location of the obstruction. When the obstruc-

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Read before the Section of Ophthalmology and Otolaryngology of the District of Columbia Medical Society, April 21, 1939.

1 Richards, L. Congenital Atresia of the External Auditory Meatus, *Ann Otol., Rhin. & Laryng.* **42**: 692 (Sept.) 1933.

tion is in the cartilaginous portion of the canal diagnosis is comparatively easy. The closer the obstruction is to the external end of the canal, the shorter is the canal as compared with that on the good side, and the easier is the diagnosis.

If the obstruction, on the other hand, is in the osseous portion of the canal, diagnosis is extremely difficult. The closer the obstruction is to the normal position of the drum, the more difficult is the diagnosis. In such cases one often mistakes the obstruction for the normal tympanic membrane. These points are well brought out in the following case.

REPORT OF A CASE

L. S., a white man aged 37, consulted me on Sept. 30, 1938, at which time he complained of sharp pain and marked deafness in the left ear. This attack came on a few hours before I saw him and was similar to several other attacks he had had in the past twenty years. According to the history, the patient first complained of difficulty in the left ear in 1919, at which time simple irrigation afforded relief. In 1925, while a student at Boston, he had a similar experience with his ear and consulted the otologist at the Massachusetts General Hospital. Again simple irrigation of the ear was successful in allaying the symptoms. In 1930, while he was taking a shower, some water entered his left ear and caused him severe pain and deafness. He consulted a local otologist and obtained relief after the wax was washed out of the ear. In June, 1938, he experienced marked stuffiness in the left ear and consulted another otologist. He was told that he had a perforation in the drum and that treatment would be directed toward closing it. This time the treatment seemed to be of no avail. Subsequently, another otologist advised him of infection in that ear and prescribed antiseptic ear drops. This treatment also failed to bring about a satisfactory result, and one month later he had the attack during which I first saw him. Prior to the onset of these attacks he had at no time had any trouble with the ear, though the hearing in it was always muffled.

Physical examination revealed the following data. The throat was normal. There was a moderate deflection in the lower portion of the septum posteriorly. The right ear was perfectly normal. The left canal seemed to be shorter, greater in diameter and straighter than the right. In its course inward it tapered off and terminated in a concave wall, fleshy in appearance, devoid of landmarks and marginal definition and not sensitive to touch.

There was no isthmus or angulation in the canal, and this made it possible to view it entire, as well as the wall at its inner end, without pulling the auricle upward and backward. Measuring the length of the two canals, I found the left to be 1.5 cm. shorter than the right. The appearance of the wall left me puzzled, and I could not decide at the time whether it was a true tympanic membrane at the inner end of the canal.

I then proceeded to clean out of the canal a certain amount of epithelial debris mixed with wax. In the midst of this manipulation the patient exclaimed that his pain was gone and that the hearing had returned. Further examination revealed a tiny opening in the upper posterior quadrant of the supposed drum. Passing a blunt probe through this perforation I came on another cavity directed medially and with an axis forming an obtuse angle with that of the canal external to the membrane. The probe was stopped in its course inward by a membranous

obstruction which was sensitive to touch. Closing the perforation with a piece of thin rubber tissue, I found that the deafness and discomfort returned. At this time I decided that the first wall was a membranous stricture and not a true tympanic membrane. To corroborate my diagnosis I had roentgenograms made of both canals after plugging them with cotton soaked in iodized poppyseed oil. They readily demonstrated the differences in shape and length of the canals.

Further examination revealed that the eustachian tube on the affected side was patent and that the hearing of the left ear, though less than that of the right, was fairly good. In the words of the patient, "the hearing was back but muffled."

I informed the patient of my diagnosis and advised him that I would enlarge the existing perforation by removing the fleshy wall. He consented to this but refused to have it done by excision of the membrane. I then decided to burn away the membrane with electrocoagulation. With each treatment the opening became larger and the hearing noticeably better. Treatment was stopped when the hearing on the left side was equal to that on the right. At this time enough of the membrane was burned away, and it was possible to view the canal beyond it.

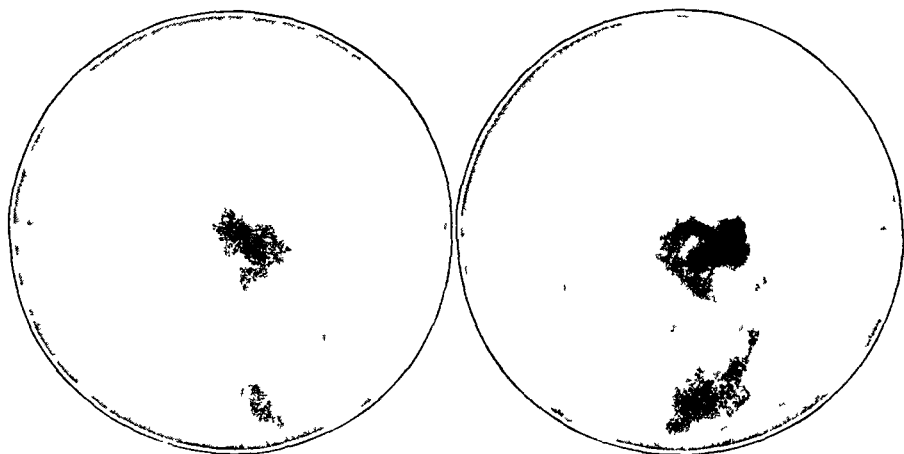


Fig 1—Lateral roentgenologic views of both mastoids with cotton soaked in iodized poppyseed oil plugging both external canals. This demonstrates the absence of infection in the mastoids.

It was normal in direction, and at the end of it I could see part of a dull gray membrane, which I assumed to be the normal tympanic membrane.

At the completion of treatment roentgenograms were again made of the canals after they had been plugged with iodized poppyseed oil on cotton. At this time, as is seen on the plates, the cotton in the left ear went beyond the obstruction, showing the length of the affected canal to be equal to that of the good side.

This case is of interest because of the following facts: (1) the ease with which the obstruction can be mistaken for the true tympanic membrane, (2) the difficulty in determining the classification of the condition, (3) the importance of a complete history, in which, as was true in this case, one often finds a clue to the correct diagnosis, and (4) the possibility of remedying the condition by means other than the knife.

Diagnosis in this case was difficult because the obstruction was in the osseous portion of the canal. Adam Politzer² spoke of such difficulty thirty-five years ago and stated that when the obstruction is close to the drum one must take cognizance of the following points: (1) definement of the margins of growth, (2) the absence of the short process of the malleus and (3) the shorter distance between the deeper parts and the external auditory orifice on the affected side than on the good side.

The classification of this deformity as to type was rather difficult. My first impression was that I was dealing with congenital atresia. But the absence of a coexisting malformation in any of the other parts

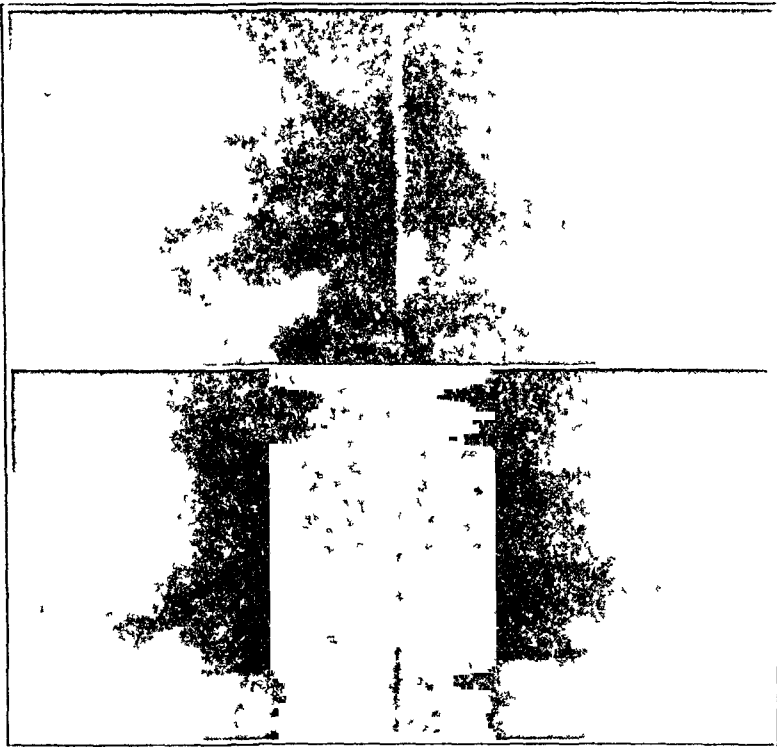


Fig. 2—Above, anteroposterior view of the mastoids, the dark areas demonstrate the extent of the canal on each side, the left canal is much shorter than the right, the canals are filled with cotton soaked in iodized poppyseed oil. Below, the same after the left external auditory meatus was recanalized by means of electrocoagulation, the canals seem to be of the same length.

of the ear deterred me from this opinion. On the other hand, there seem to be no definite etiologic factors for acquired atresia.

Consequently, I thought it best to canvass the opinions of some nationally known otolaryngologists, and I am quoting from their communications:

² Politzer, A. A Text-Book of the Diseases of the Ear, ed. 4, translated and edited by M. J. Ballin and C. L. Heller, London, Baillière, Tindall & Cox, 1902, p. 216.

Harold Hays ³

My own feeling in the matter is that the atresia resulted from some inflammatory process in the auditory canal, of which the patient might have been unaware

George M Coates ⁴

I have once or twice, I think, seen what appeared to be cicatricial closures of the canal external to the drum, but not for a long while I do not know what the cause of them is It is possible that they might be congenital, but I suspect that some trauma may have been responsible I really do not know

Lyman Richards ⁵

To me the best explanation of this problem seems to be congenital atresia of the left canal with periodic occlusion of the isthmus by cerumen and epithelial debris I should say that the method of treatment was most commendable and ingenious

Three other otologists to whom I have written have, at the time of writing, failed to render an opinion in the case

The treatment of atresia of the external auditory canal advised by all authorities is surgical removal of the obstruction followed by implantation of a Thiersch graft Unless the membranous septum is unusually thin, the procedure is fraught with difficulties because of the limited space to work in and the profuse bleeding encountered Electrocoagulation, on the other hand, is, in my estimation, a much cleaner and easier method Complete anesthesia in the obstructed area was difficult to obtain I applied a 10 per cent solution of cocaine hydrochloride topically without good results The patient, however, did not seem to experience much pain or burning sensation when the current was applied, and I was able to recanalize the ear without any difficulty

In conclusion, I wish to stress the following points (1) the difficulty in determining the classification of the condition, (2) the ease with which such a deformity can be overlooked, (3) the importance of taking a thorough and detailed history and carefully analyzing it and (4) the feasibility of substituting the electrocoagulation needle for the knife in the surgical treatment of such a deformity

3 Hays, H Personal communication to the author, May 4, 1939

4 Coates, G M Personal communication to the author, May 5, 1939

5 Richards, L Personal communication to the author, May 8, 1939

SHORT WAVE DIATHERMY IN TREATMENT OF NASAL SINUSITIS

A R HOLLENDER, M D

MIAMI BEACH, FLA

With the introduction of diathermy as a new and more effective thermotherapeutic agent as compared with the then available methods of conveying external heat to the body, efforts were made to apply this agent in the management of nasal sinusitis. The results have not been such as to encourage its general use in rhinologic practice. For reasons to be set forth, the advent of short wave diathermy gave an impetus to renewed experimental and clinical research with a view to obtaining favorable effects on certain inflammatory processes. The results of this research have brought about the present tendency to include the newer agent alone or as an adjunct to other measures in the management of inflammatory processes of the accessory nasal cavities.

Actual and alleged differences between the older, or conventional, type of diathermy and the later types of short wave diathermy necessitate a brief reference as a common basis for discussion of the clinical aspects under consideration.

The entire problem has been tersely disposed of by the Council on Physical Therapy of the American Medical Association¹ in these words:

Medical diathermy is the therapeutic use of heat generated in the body tissues by a high frequency current which has insufficient local intensity to produce temperatures high enough to destroy the tissues or impair their vitality. Such currents are applied locally by three methods: (1) conventional long wave diathermy, contact metal electrodes being used, (2) short wave diathermy with an electric field, air-spaced or insulated electrodes being used, and (3) short wave diathermy with an electromagnetic field method, a cable being used.

In conventional or long wave diathermy the frequency of oscillation is usually from one-half to three million cycles per second. In short wave diathermy the frequency of oscillations may be from ten million to 100 million cycles a second.

Claims have been advanced by certain authors that short wave diathermy is an entirely new and distinct method of therapy because, apart from its acknowledged ability to produce heat in depth, it possesses peculiar physiologic and biologic properties affecting cellular life, an assertion not devoid of a certain element of mysteriousness. This phase

¹ Medical Diathermy, report of the Council on Physical Therapy, J A M A **112** 2046 (May 20) 1939

of the problem is disposed of by the Council in the statement "In the light of present observations, the consensus seems to be that no physiologic effects other than those attributable to heat have been substantiated," a statement with which I am in full accord

There is, however, no question that a difference between the two types of diathermy mentioned does exist. This difference, to which I shall refer later in greater detail, consists essentially in the fact that short wave diathermy easily overcomes the ohmic resistance offered to the ordinary diathermic current by osseous structures and therefore is capable of creating heat in bones, a factor which at once suggests new therapeutic possibilities in regions of the human body containing bony structures, and therefore in the management of nasal sinusitis

RATIONALE OF HEAT THERAPY

It was Bier² who first pointed out the role of inflammation as a natural reaction in repair of disease processes. Diseased accessory nasal sinuses do not differ pathologically from other organs with infectious processes, so that a remedy effective in one part of the body should prove equally beneficial in an analogous situation elsewhere. The employment of heat for its localized, hyperemic effect is not new, having been the mainstay of pioneer workers in electrotherapy. The most effective method of inducing heat on the surface of or in the body has been the chief objective of modern investigators³ and has led to the introduction of improved sources of heat energy for this purpose.

The analgesic effect of local heat is well recognized. It is also known that local heat irradiation increases local tissue metabolism, permitting a more rapid defensive response to disease. With increased vitality of the tissues, resorptive powers enable resolution to take place more readily, unless hindered by intervening forces.

The evolution of artificial heating sources has involved a large number of objects and appliances, the difference in most of them being one of technical convenience rather than of therapeutic superiority. The signal difference is not so much in the manner of production of heat as in the fact that by diathermy heat may be produced at levels considerably below that of the subcutis. As has been mentioned, the main advantage obtained from short wave diathermy is the indisputable fact

² Bier, A. *Hyperemia as a Curative Remedy*, ed 2, Leipzig, F. C. W. Vogel, 1905.

³ Hollender, A. R., and Cottle, M. H. *Diathermic Studies on the Eye and Ear*, *Arch. Otolaryng.* **3**: 438 (May) 1926. Moncrieff, W. F., Coulter, J. S., and Holmquest, H. J. *Experimental Studies in Diathermy Applied to the Eye and Orbit*, *Am. J. Ophth.* **16**: 193 (March) 1932.

that it creates heat at much greater depths than was possible with conventional diathermy, and that bony structures which present an almost insurmountable obstacle to the penetration of the longer waves are easily passed through by the short waves. Considering the osseous structure of the head and face, it is evident that the treatment of sinusitis has been rendered more effective by the added use of short wave diathermy.⁴

Aside from the hyperemic action, deep heat stimulates the flow of lymph and, if continued for a length of time, produces edema. Analgesia may be attributed to these phenomena, since they control infection through the very increase of the inflammatory process. Accordingly, the concept is justified that inflammation is a natural defensive reaction which should be augmented within certain limits rather than suppressed, and that the therapeutic value of heat is ascribable to hyperemia and hyperlymphia.⁵

INDICATIONS AND LIMITATIONS

While all that has been said applies at least in part to heat from any source, that produced by the high frequency current creates the phenomena at greater intensity. To this should be added that with conventional diathermy one hesitated to risk its application in cases of acute suppurative processes without drainage first having been established. Experience has shown that this limitation does not obtain with short wave diathermy. While this method can be safely applied to empyemic conditions of any of the sinuses, claims of European workers⁶ that surgical intervention is obviated have not been substantiated.

Short wave diathermy is not a panacea, and only in a few instances has it produced favorable results without the additional use of other measures. The tendency to employ diathermy alone in the treatment of nasal sinusitis is objectionable. Furthermore, its use without an exact diagnosis having been made, as is often the case with certain practitioners, is likely to place this valuable agent in the category of unscientific procedures. When a pathologic process is such that it obviously can be eradicated only by operation, precious time will be lost in seeking to obtain relief from nonsurgical therapy.

The proper selection of cases is one of the primary requisites for the scientific utilization of short wave diathermy as a therapeutic adjuvant. It is essential to differentiate the various types of sinus disease, and for this purpose every clinical and laboratory means should be resorted to in order to assure a correct diagnosis.

4 Kobak, D. Radiathermy in Medicine, *Arch. Phys. Therapy* **16** 5 (Jan) 1935.

5 Hollender, A. R. Clinical Evaluation of Short-Wave Diathermy in Otolaryngology, Eye, Ear, Nose & Throat Monthly **16** 410 (Jan) 1938.

6 Schliephake, E. The Importance of Ultra-High Frequency Therapy, *Arch. Phys. Therapy* **14** 389 (July) 1933.

In spite of what has been said regarding the applicability of short wave diathermy to acute suppurative processes, drainage should be established in every case at the proper time. This is rightly emphasized in the report¹ of the Council on Physical Therapy, which states

Infra-red irradiation and medical diathermy are useful adjuncts to other treatment after adequate drainage has been established. Medical diathermy is of value as an aid in the relief of pain, the frontal and maxillary sinuses are the ones most suitable for treatment.

REVIEW OF PROGRESS

Several workers have investigated the value of short wave diathermy in the treatment of nasal sinusitis. In most instances local tissue temperature was not appreciably elevated, or was elevated only slightly. Tebbutt⁷ expressed the opinion that topical heat is of definite value despite the drop in temperature in the sinuses, explaining, however, that this phenomenon is apparently a part of the mechanism involved in the regulation of the temperature of the body. In an effort to reconcile the favorable clinical effects with the experimental findings, Andreen and Osborne⁸ conjectured

The benefit received from such methods is due in part to an increased circulation leading to an active hyperemia rather than any change in temperature.

Bierman⁹ expressed the belief that heat is definitely of value in the treatment of sinus disease. He and his co-workers observed marked relief from pain after the application of short wave diathermy. Many of his patients had been under treatment by specialists for years. Talia¹⁰ reported satisfactory results from the treatment of chronic sinusitis by short waves. According to him, the patients who do not respond favorably to this treatment do not improve under any form of medical treatment and therefore should be subjected to operative therapy.

CLINICAL STUDIES

With a view to evaluating correctly short wave diathermy in treatment of disease of the nasal sinuses, I repeated the temperature studies of Andreen and Osborne⁸ and of Rosenwasser and Bierman¹¹. In

7 Tebbutt, H. K. Effect of Physical Agents on the Temperature of the Nasal Sinuses, *Arch Otolaryng* **22** 733 (Dec.) 1935.

8 Andreen, M. A., and Osborne, S. L. Measurements of the Temperature of the Maxillary Sinus After Treatment by Various Methods of Heating. A Comparative Study, *Arch Otolaryng* **24** 331 (Sept.) 1936.

9 Bierman, W. Short-Wave Currents, *Arch Phys Therapy* **18** 79 (Feb.) 1937.

10 Talia, F. La marconiterapia nelle sinusiti croniche, *Arch di radiol* **13** 23 (Jan-April) 1937, abstracted, *J. A. M. A.* **109** 1408 (Oct. 23) 1937.

11 Rosenwasser, H., and Bierman, W. Effect of the Short-Wave Current on the Temperature of the Paranasal Sinuses, *Arch Otolaryng* **25** 555 (May) 1937.

20 selected cases of acute exacerbation of maxillary sinusitis, in which the taking of temperatures through a window was feasible, the following results were given. In 10, there was an elevation of temperature ranging from 0.6 to 1.5 F, in 4 there was no gain or loss, and in the remaining 6 there were losses ranging from 0.4 to 1 F. No analgesic was applied intranasally previous to the experiments, because earlier work had shown that cocaine and other anesthetics influence the results. The treatments were given with air-spaced electrodes over the affected antrum for periods of fifteen minutes, and in all cases the same apparatus was employed.

In a second series of 18 cases of acute maxillary sinusitis, short wave diathermy (from a 6 meter apparatus) was applied without resort to any other therapy. In a control group orthodox procedures were employed without short wave diathermy, and in a third group short wave treatment was added to accepted routine measures. In the first group, after four days, 6 of the patients had to be given relief by irrigation, shrinkage and suction. The most favorable response was obtained in the third group, in which short wave therapy was combined with routine treatment of the sinuses. The most unfavorable result was noted in the group treated by short waves alone. In judging results, factors such as pain, tenderness, character of discharge, facility of drainage, constitutional symptoms and results of transillumination were taken into consideration. When it was believed that treatment had been completed, as determined by the factors mentioned, roentgenograms were made and compared with the original. Sufficient time was permitted to pass before a result was considered as final.

In a third series of 14 selected cases of chronic maxillary sinusitis (inflammatory and suppurative, but not definitely hyperplastic), in which the patients had previously been subjected to numerous nonsurgical methods of treatment over periods varying from one to five years, diathermy was tried to evaluate its effectiveness. Seven patients were treated with diathermy alone, and 7 had the benefit also of intranasal and constitutional remedies. Of the 7 who had short wave diathermy alone, only 1 showed moderate improvement, in the other group of 7, 2 showed a decided favorable change, and in only 1 was the improvement slight. These two groups of patients were treated over a period of one year, with an intermission after each course of fifteen applications. During the latter part of the trials the periods of treatment were extended to twenty minutes, but these had to be reduced because they produced temporary discomfort. In the earlier courses treatments were given daily, subsequent courses consisted of applications on alternate days. Here, as in the experiment with the acute conditions previously described, the same factors were used to judge possible clinical changes.

COMMENT

These studies demonstrate three important facts in connection with the use of short wave diathermy in treatment of acute and chronic nasal sinusitis

1 Short wave diathermy is not in itself sufficiently effective in treatment of acute sinusitis to be employed to the exclusion of other recognized therapeutic procedures

2 Short wave diathermy is not a curative method of treatment of chronic sinusitis, when used either alone or in combination with other nonsurgical measures

3 Short wave diathermy is an effective aid to indicated accepted procedures in cases of acute sinusitis, hastening the abatement of symptoms and shortening the course of the disease

From these observations it is evident that claims of other workers in uncontrolled cases cannot be accepted as accurate. Furthermore, there is an element of danger in the treatment of acute nasal sinusitis when short wave diathermy, or any other single procedure, is employed without regard for immediate improvement of intranasal and sinusal ventilation and drainage. It seems futile to employ short wave diathermy in cases of chronic sinus disease which has persisted over long periods in spite of other intensive methods of therapy.

SUMMARY

1 The introduction of short wave diathermy has led to a more general utilization of heat therapy in the management of inflammatory processes

2 Local deep heating of the anatomic areas in which the sinuses are situated produces analgesia through hyperemia and hyperlymphia, improves tissue metabolism, increases resorption and consequently brings about a more rapid defensive response to infection

3 Proper selection of cases is one of the primary prerequisites for the scientific utilization of short wave diathermy as a therapeutic agent in cases of nasal sinusitis

4 Experiments reveal that local tissue temperature is not appreciably elevated, or is elevated only slightly, a fact which is not altogether reconcilable with clinical results, especially in cases of acute sinusitis

5 Short wave diathermy is not in itself sufficiently effective as a therapeutic agent in acute sinusitis and may occasionally lead to serious consequences when conventional treatment is omitted

6 Short wave diathermy is an effective therapeutic aid to other procedures in cases of acute maxillary sinusitis, but is practically valueless in the large majority of cases of chronic disease of the maxillary sinus

TREATMENT OF ACUTE SUPPURATIVE OTITIS MEDIA

DOES DOUCHING OF THE EAR SPREAD INFECTION TO THE
MASTOID CELLS?

OTTO C HIRST, M D
PHILADELPHIA

This discussion presupposes a diagnosis of acute suppurative otitis media and a patient presented with a discharging ear from either spontaneous rupture or incision of the tympanic membrane

The objects to be attained by treatment in addition to symptomatic relief include, as outlined by Macfarlan¹ in 1931, (1) bacteriologic determination of the type of infection, (2) removal of local or general causes of reinfection, (3) securing and maintaining of good drainage, (4) aseptic cleansing, (5) termination of the discharge and (6) restoration of hearing. These objectives are still excellent guides to treatment.

BACTERIOLOGIC DETERMINATION OF THE TYPE OF INFECTION

The bacteriologic determination of the type of infection is more important today than in 1931 for two reasons. First, it leads the physician to a knowledge of what is to be expected during the course of the two gross types—those caused by the streptococcus and those caused by the staphylococcus. This knowledge is extremely helpful in the outlining of treatment, particularly in the event that the suppurative otitis media is complicated by acute mastoiditis. The pathologic picture and further complications are not alike, and the two types demand different treatment. Second, it is well known that sulfanilamide is most useful in the treatment of otitic infections due to beta hemolytic streptococci and to certain of the pneumococci. While it seems feasible that it might prove effective against all organisms producing an exotoxin, the knowledge that one's patient has an infection due to a hemolytic streptococcus or the pneumococcus type III demands treatment with sulfanilamide or one of its related compounds.

Read at the monthly staff meeting of the Hospital of the Protestant Episcopal Church, Philadelphia, April 27, 1938, and at a regular meeting of the Bucks County Medical Society, June 8, 1938.

From the department of otolaryngology, service B, of the Hospital of the Protestant Episcopal Church and the otorhinologic service of Dr. George M. Coates, Graduate School of Medicine, University of Pennsylvania.

1. Macfarlan, D. Lecture to the students of the Graduate School of Medicine, University of Pennsylvania, 1931.

My experience with this drug coincides with the mounting cures reported in the literature

Until more is known of the drug, this form of chemotherapy is an excellent adjunct to, but not a substitute for, surgical measures for otitic infections. As in most cases acute suppurative otitis media is due to the streptococcus, I believe sulfanilamide should be used from early in the course until the patient is cured or it is proved that the invading organism is of a type not destroyed by the aid of sulfanilamide

REMOVAL OF LOCAL CAUSES OF REINFECTION

In considering the removal of local causes, it must be remembered that the eustachian tube is a part of the middle ear, that in children it is shorter and more patulous and that most infections of the middle ear are secondary to infections of the nasopharynx and sinuses

Treatment of the middle ear should therefore include treatment of the nasopharynx, sinuses and eustachian tubes. Measures instituted to combat infection and inflammation of these parts will help in normally conveying infectious material through the eustachian tube to the pharynx. An aural discharge will continue from the external canal until it can be conveyed through the eustachian tube

On this score, in an endeavor to secure better aeration and drainage of the nose and sinuses, I use 0.5 to 1 per cent ephedrine hydrochloride in a 0.6 per cent saline solution, 5 to 40 drops in each nostril according to the age of the patient, alternated every two hours with the vapor of benzedrine. When drops are used, the patient is placed in the Proetz head-low position

Inhalation of benzedrine is particularly useful in reducing the inflammation about the mouths of the eustachian tubes. Swallowing with the nostrils closed will help in starting exudates through the eustachian tubes to the pharynx

After the acute symptoms subside, adenoids or other masses about the pharyngeal mouths of the eustachian tubes should be removed

It has been my experience that, with careful instruction in the method of administering the nasal drops, the more thorough the treatment of the nasopharynx and sinuses, the more rapidly the appearance of tubal patency will result, and with it will come normal drainage of the ear

Drainage, a primary requisite of treatment, will be hampered by any obstruction in the external canal. This may include inspissated pus, epithelial scales, wads of macerated skin flakes or closure of the external meatus, secondary to complicating diffuse external otitis

MAINTAINING DRAINAGE

As to maintaining free drainage and aseptic cleansing, considerable partisan argument has arisen at times regarding the merits of the

so-called "dry" and "wet" methods of treatment in cleansing an acutely suppurating middle ear. Some otologists have suspected that irrigation or douching of the ear for acute otitis media spreads infection to the mastoid cells.

Of course, all are aware that there is a class of fulminating conditions in the presence of which the mastoid cells and middle ear become involved simultaneously. Mastoiditis in these instances is not due to the retention of pus within the tympanic cavity, to its obstruction in the external meatus or to the after-treatment. Consequently, one cannot expect to obviate the mastoiditis by any manner of otologic treatment to maintain drainage, since the etiologic factor is not interference with adequate drainage.

The dry treatment, on the other hand, presupposes personal attention by the physician at such frequent intervals that for practical purposes in dispensary and most private practices it is rarely available in the average case.

To determine whether irrigation solutions enter mastoid air spaces, Shapiro,² in 1933, irrigated the ear with a 1 per cent solution of methylenethionine chloride (methylene blue) one hour prior to mastoid operation. In 5 cases no trace of the dye was discovered in the mastoid cavity.

In an experiment on 2 cadavers he completely removed the tympanic membranes and similarly injected the dye. He allowed the fluid to remain in the external canal and middle ear of the first cadaver. It was found in the cells at mastoidectomy. He stated the belief that the solution penetrated the mastoid cells as soon as the cortex was opened permitting the escape of air.

In the experiment on the second cadaver he followed the same technic but used more force and dried the canal before opening the cortex. The dye was found staining the throat as it had passed through the eustachian tube. The mastoid cells, however, were free from dye.

He concluded from his experiments that when solutions are injected into the middle ear they cover the only outlet for the air, the aditus ad antrum, and, since the air cannot escape, the solution cannot enter.

I believe this conclusion to be erroneous. It was found possible to fill a bottle having a $\frac{1}{8}$ inch (0.32 cm.) mouth with solution by a continuous stream directed against the mouth. As air bubbled out, due to the pressure of the stream, the solution dropped into the bottle either in the upright or in the horizontal position. Similarly, a solution passed by stream through the external meatus could reach the mastoid cells.

It has been my experience that most advocates of the so-called "wet method" of treating acute otitis do not irrigate the ears with a large

² Shapiro, D. Irrigation of the Ear in Acute Otitis Media, *Arch. Otolaryng.* 17:384 (March) 1933.

amount of solution from an irrigating can but advise the use of the 1 ounce (30 cc) pear-shaped rubber bulb with a soft, tapered end

The attendant is instructed to direct the stream along the meatal walls and not against the drum membrane. Pain and vertigo follow carelessness in this regard. To permit better flow of the solution, the canals in adults are straightened by pulling the auricle up and back, and in children, down and back. Straightening the canal also prevents retained solution, internal to the isthmus, from macerating its walls. The canal is thus douched until the return flow is clear. Four or 5 ounces (120 to 150 cc) of solution is usually sufficient. The canal is then dried by first blowing air into it with the rubber bulb and then applying long, firmly rolled, cylindric cotton pledgets.

To simulate their technic more closely, in 1935 and 1936 I douched the ears of 10 patients with acute mastoiditis and 3 with chronic mastoiditis with a 1 per cent solution of methylthionine chloride (methylene blue) immediately before mastoidectomy.

One patient with a chronic condition had a large perforation of the tympanic membrane, and 2 had acute exacerbation of a chronic infection with a small perforation. Of the 10 patients with an acute condition, 4 had had previous myringotomy, 5 had had spontaneous rupture of the tympanic membrane before being brought to the clinic, and 1 had had myringotomy performed despite spontaneous rupture. The ears were not dried of the solution before operation, and no trace of the dye was found in the presence of an acute condition or of a chronic condition with a small perforation of the tympanic membrane. It was found, however, in the antral cell of the patient with a chronic condition and a large perforation of the drum membrane.

In addition to using this technic at operation I performed similar experiments on 3 cadaver ears. The tympanic membrane of 1 was incised. The drum membranes of the others were absent. The canals and middle ears were thoroughly dried before mastoidectomy. Methylthionine chloride (methylene blue) solution was found in the 3 mastoid processes.

With this experience and that of the dye being found at operation on the patient who had chronic mastoiditis with a large perforation of the tympanic membrane, I am compelled to differ with Shapiro and state that it is possible to carry infection from the external canal to the mastoid cells in the presence of a chronic condition with a large perforation. This is probably one of the reasons why some patients with chronic suppurative otitis media are not cured by the douching treatment of their ears.

I agree with Shapiro and have proved to my satisfaction that it is not possible to carry infection to the mastoid cells in the presence of an acute condition.

I believe that it is the acute swelling of the mucosa, the relatively small perforation and the high position of the aditus ad antium in relation to the line of incision of the myringotomy or the spontaneous perforation which prevent douching solutions from entering the mastoid cells in the presence of an acute condition

ASEPTIC CLEANSING

As to aseptic cleansing, those who uphold the value of douching or irrigations have used various solutions, including solution of formaldehyde, chlorine, the dyes, alcohol, mercury bichloride, boric acid and physiologic solution of sodium chloride. Solutions of alcohol and of formaldehyde cause a considerable burning sensation following their use in the presence of an acute condition and therefore are not widely used. Weak alcoholic solutions are not bactericidal. Solutions of chloride and of mercury bichloride are not generally used because of the increased likelihood of maceration of the meatal skin. So, by heritage and empiricism, otologists have had given to them the almost universal use of boric acid solution. This solution is only weakly bacteriostatic and definitely nongermicide.

The newer, nonirritating salts of mercury have been reported definitely germicidal by Schamberg, Kolmer and Raiziss³ and 100 per cent effective for antisepsis of the skin by Birkhaug⁴. They are nonirritating to the skin in proper dilution. They are compatible with 95 per cent alcohol. One of them, the anhydride of 4, nitro-5-hydroxymercuri-orthocresol (metaphen), containing about 56 per cent mercury, was selected for use. When used every two or three hours in a 1 to 10,000 dilution, it was found not to macerate or irritate the skin in acute cases.

The proneness of the meatal skin to fissures, funicles and acute diffuse external otitis is well known. In a majority of the cases observed acute suppurative otitis media is complicated by external otitis as a result of the irritating discharge. Gleason⁵ made the following statement:

Diffuse inflammation of the [external] auditory canal varies in character from a simple erythema of the skin to severe periostitis [of the canal]. The disease [is] usually [limited to] the osseous portion of the canal, but it may extend to the auricle, and, by periosteal continuity, to the periauricular and mastoid regions, causing abscess and necrosis.

3 Schamberg, J., Kolmer, J., and Raiziss, G. A New and Superior Mercurial Germicide, *J. A. M. A.* **68** 1458 (May 19) 1917.

4 Birkhaug, K. E. Metaphen (4-Nitro-3, 5-Bisacetoxy-Mercuri-2-Cresol) A Comparative Study of Commonly Used Disinfectants and Antiseptics, *J. A. M. A.* **95** 917 (Sept 27) 1930.

5 Gleason, E. B. A Manual of Diseases of the Nose, Throat and Ear, ed 2, Philadelphia, W. B. Saunders Company, 1910, p. 337.

The last-named condition is often difficult to differentiate from acute mastoiditis and certainly complicates the treatment

I have repeatedly heard patients with simple erythema complain of severe pain when the cotton probe is passed over the area and believe that much of the pain of which patients complain while having an acute condition competently treated is due to the complicating external otitis. Therefore, measures to prevent or treat the external otitis should be included in the treatment of the suppurating middle ear. This can be accomplished by douching the discharges from the external canal by a germicidal solution and applying a bland antiseptic ointment to the meatal walls.

After the acute condition has subsided, usually in seven to fourteen days, alcohol is added to the mercurial germicide because of its astringent effect on the mucosa. I start with 35 to 40 per cent alcohol gradually increasing the strength of the alcohol to 95 per cent. Later in the course of the infection, as the higher percentage of alcohol is reached, some patients complain of its burning sensation. This can be obviated by instilling 5 drops of a 2 per cent solution of pontocaine hydrochloride five minutes before the douche. Schmidt⁶ stated

[The astringent action of alcohol] gives the exudate a better outlet through the wider hole in the tympanic membrane.

When the hole in the tympanic membrane is widened by the shrinkage and the Eustachian tube is opened for outflow of the exudate, and the greatly thickened mucous membrane of the middle ear has shrunk through the astringent effect of the alcohol, the best conditions [have been produced] for ventilation [and drainage] of the mastoid cells.

Macfarlan⁷ concluded

There is no excuse to allow the ear to discharge indefinitely, nor intermittently.

If methods such as are here suggested, are conscientiously carried out and the discharge continues [longer than eight weeks, drainage through the external auditory meatus is evidently inadequate, and a] simple mastoid operation should be done. [Possible general and local causes of prolonged discharge must first be eliminated.]

All these interests are directed [not only toward the prevention of further complications but] toward the preservation of hearing, the loss of which is so often irreparable.

CONCLUSIONS

1 Under ordinary circumstances, douching of an acutely suppurating middle ear will not carry infection into the mastoid cells.

6 Schmidt, V. Treatment of Acute Suppurative Otitis Media by Svinging with Alcohol, *J. Laryng. & Otol.* **50** 594 (Aug.) 1935.

7 Macfarlan, D. Methods of Caring for the Discharging Ear, *Pennsylvania M. J.* **36** 29 (Oct.) 1932.

2 The mercurials of the orthocresol group, alone or with alcohol, are satisfactory douching solutions

3 The treatment of external otitis should be included along with that of suppurating otitis media

4 Sulfanilamide therapy can be used to advantage in the treatment of the majority of acute otitic infections

5 Otitic suppurations, continuing eight weeks or longer, demand simple mastoidectomy as a measure directed toward the preservation of hearing

BENIGN CYSTS AND ADAMANTINOMAS OF THE JAWS

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Cysts and cystlike lesions of the jaws are encountered frequently. Adamantinomas are relatively rare. Many of the so-called dentigerous and radicular cysts are small, but these and certain other cysts may become large. This paper deals mainly with larger cysts and with adamantinomas. It is based on a study of a series of 198 cases of benign cyst and of 58 cases of adamantinoma, approximately a third of the cases in each group having come more or less closely under my observation.

In the second month of fetal life¹ infolding of the gingival epithelium takes place to form the dental ridge. At intervals along the dental ridge epithelial buds push into the mesoderm, these become pedunculated and bulbous and are then known as "enamel organs." In the fourth month the mesoderm pushes into the deeper surface of the bulbous enamel organ, invaginating it and converting it into a bell-shaped structure (fig. 1). On the inner and outer surfaces of the bell are thin layers of flat epithelial cells, which are sometimes called the "inner and outer tunics." Those epithelial cells that fill the space between them assume a stellate form, with mucoid material in the interspaces, and comprise the stellate reticulum.

The invaginating mass of connective tissue is known as the "dental papilla." Its outer cells become specialized to produce dentin, while those of the central portion eventually become the pulp of the tooth. A single layer of epithelial cells of the inner tunic lying next to the crown portion of the dental papilla becomes specialized to produce enamel. These are the ameloblasts. The inner and outer tunics of the enamel organ over the root portion of the dental papilla become compressed to form a loop or duplication which encircles the forming root. This is known as the "sheath of Hertwig" and is thought to determine the shape of the root and to regulate the formation of dentin. During this process

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1. Kronfeld, R. (a) Histopathology of the Teeth and Their Surrounding Structures, Philadelphia, Lea & Febiger, 1933, (b) Dental Histology and Comparative Dental Anatomy, *ibid*, 1937.

small groups of epithelial cells become detached from it and embedded in the surrounding connective tissue. These, together with occasional persisting remnants of Heitwig's sheath or of other portions of the enamel organ, make up the epithelial "debris" of Melassez, whose theory that certain cysts and tumors of the jaws arise from this "debris" is accepted generally.

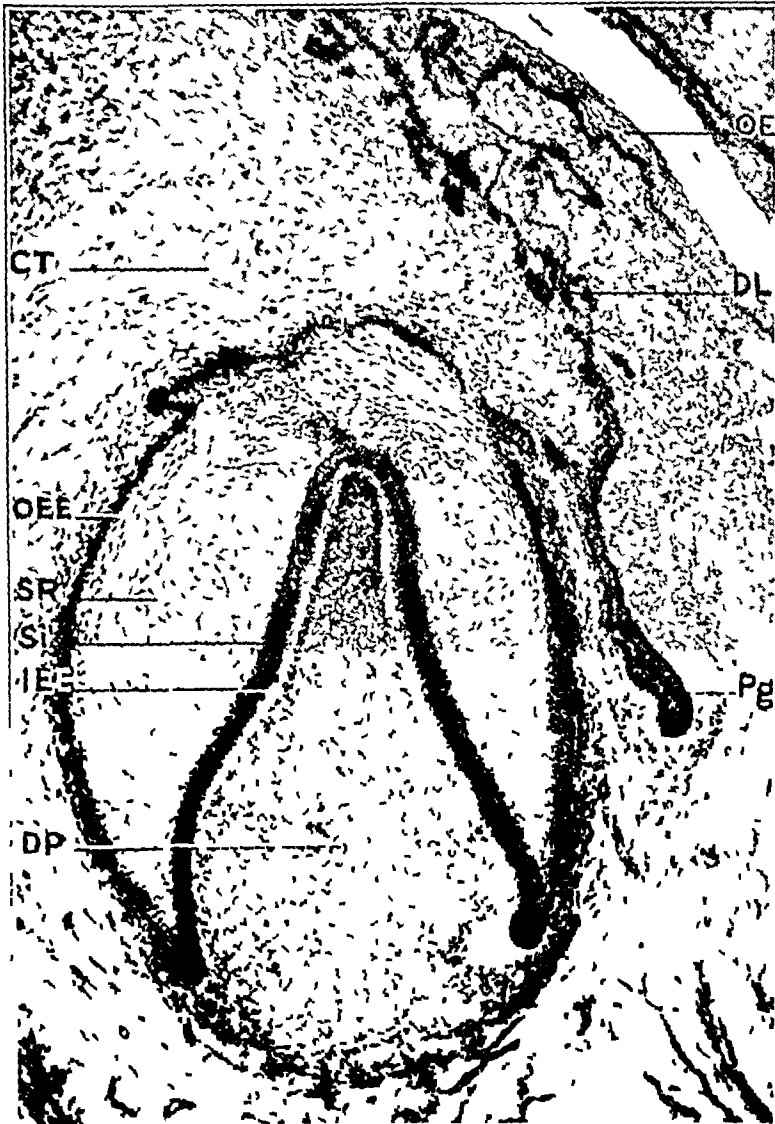


Fig 1 (from Kronfeld,^{1b} with permission of the author) —Bell-shaped enamel organ at the deciduous cuspid of a human embryo of the fifth fetal month, *OE* indicates oral epithelium, *DL*, dental lamina, *Pg*, anlage of permanent cuspid located on the lingual side of the enamel organ of the deciduous cuspid, *OEE*, outer enamel epithelium, *SR*, stellate reticulum, *Si*, stratum intermedium, *IEE*, inner enamel epithelium, *DP*, dental papilla, *CT*, connective tissue of tooth follicle (*OEE* is referred to in the text as the "outer tunic," *Si* plus *IEE* are together referred to as the "inner tunic")

The term "odontoma" is used to include tumors and cysts of the jaws which originate from dental embryonic remnants. The type of tumor or cyst arising as a result of proliferation of these epithelial remnants

depends not only on the type of cells from which it originates but also on the degree of their differentiation. If a tumor of well differentiated cells originates from the remnants of the tunics or of the stellate reticulum, cystic degeneration occurs, with the formation of an epithelium-lined, mucus-filled cyst (follicular cyst). The proliferating cells may resemble those of the layer of ameloblasts and result in a solid tumor, which is usually, though not always, calcified (solid odontoma). If little or no differentiation occurs, a tumor made up of nests of embryonic cells (adamantinoma) results. The solid odontoma will not be considered in this paper except to point out that when uncalcified it may be indistinguishable roentgenographically from a cyst.

For clinical consideration of cystic odontomas and of benign cysts of the jaws of nondental origin the following outline is helpful:

- 1 Cystic odontomas
 - (a) Follicular cysts
 - (1) Those containing an associated tooth
 - (2) Those not containing an associated tooth
 - (b) Adamantinomas
- 2 Cysts of inflammatory origin
- 3 Cysts of traumatic origin
- 4 Cysts of indeterminate origin
- 5 Cysts developing from nondental embryonic rests
 - (a) Median anterior maxillary cysts
 - (b) Facial cleft cysts

In the differential diagnosis the following lesions must be borne in mind. Clinically and roentgenologically any of them may be indistinguishable from a cyst. Exploration and biopsy may be necessary to establish the true diagnosis.

- 1 Giant cell tumor
- 2 Uncalcified solid odontoma
- 3 Fibroma
- 4 Dermoid
- 5 Angioma
- 6 Hemangioendothelioma
- 7 Metastatic malignant tumor
- 8 Osteitis fibrosa cystica
- 9 Paget's disease
- 10 Fibrocystic disease
- 11 Sarcoma
- 12 Chondroma
- 13 Squamous cell epithelioma invading the jaw

FOLLICULAR CYSTS

Recalling that the developing tooth is surrounded by those portions of the enamel organ which normally undergo atrophy (the stellate reticulum, the outer tunic and all but the single layer of enamel-forming cells from the inner tunic), one readily sees that if a cyst forms as a result of proliferation beginning in remnants of any of these structures lying superficial to a tooth, its eruption will be interfered with and the cyst will be likely to surround the tooth more or less completely. If the process begins alongside the tooth, its eruption may continue with little or no disturbance, and the cyst may come to lie below or partially surrounding its root. With the enlargement of the cyst and resorption of the surrounding bone, it may finally come to underlie or partially surround the roots of several teeth.

In cases in which roentgenologic examination reveals a cyst containing a tooth, it can often be noted that a tooth is absent from the number normally present in that region. Occasionally, however, the full quota of teeth are present, and the tooth in the cyst proves to be an anomalous one. Rarely, a tooth is missing and a cyst is found which does not contain a tooth, in such cases one must assume that the enamel organ failed to function.

These cysts affect males and females with about equal frequency, and they are a little more likely to be found in the lower than in the upper jaw. They are discovered with equal frequency in the third, fourth, fifth and sixth decades of life, about half as frequently in the second and seventh decades and only occasionally at other ages. The youngest patient at the Mayo Clinic was a child of 20 months.

Follicular cysts may produce no symptoms and be found only on routine roentgenologic examination. When present, symptoms most often are of six months' duration or less, although some patients describe symptoms dating back as long as two years and occasionally longer. One patient at the Mayo Clinic had had trouble for thirty years. Painless swelling is the complaint most frequently noted. Painful swelling, swelling with discharge and a persistent sinus after extraction of a tooth are each noted occasionally.

The diagnosis usually can be made with reasonable assurance on roentgenologic examination. The smooth bony cavity is clearly outlined without evidence of thickening of the margins. The cyst almost always is unilocular.

Treatment consists of complete removal of the lining membrane and of one wall of the bony cavity in order to convert it into a saucer-like depression. The lining usually strips out readily. Recurrence rarely follows this method of treatment.

Some have advocated simply opening the cyst and inserting a drainage tube for a period sufficient to permit continuous epithelization between the lining of the cyst and the mucous membrane of the mouth. It has been claimed that if this is done the cavity eventually will disappear. I have had no experience with this method.

On microscopic examination follicular cysts usually are found to be lined with squamous epithelial cells. Long-continued infection may destroy the epithelial lining, in which case thick fibrous inflammatory tissue replaces it.

CYSTS OF INFLAMMATORY ORIGIN

Cysts of inflammatory origin are known as "radicular cysts" and result from infection at the tip of a pulpless tooth. They may or may not have an epithelial lining, which is believed to develop from fragments or remnants of Hertwig's sheath. If an epithelial rest lies in the wall of an abscess, the cells proliferate to provide a lining for the cavity of the abscess.

Usually these cysts are small, and often they adhere to the root when the tooth is extracted. Occasionally they become large, and unless there is an associated pulpless tooth they may be indistinguishable from follicular cysts of the type which contain no tooth.

Stafne² called attention to the apparent development of similar cysts around retained deciduous roots. He reported a case in which a radiopaque nodule surrounded by a cystic cavity was seen in the roentgenogram of the jaw of an elderly woman. At operation, a cyst lined with squamous epithelium and containing a deciduous root was found. There was no connection between the cyst and the roots of the adjacent permanent teeth.

CYSTS OF TRAUMATIC ORIGIN

Ivy and Curtis³ recently gave an excellent description of cysts of traumatic origin. They are analogous to those nonepithelium-lined cysts of long bones which have been believed to result from the formation of hematomas following trauma. An injury insufficient to cause fracture may lead to hemorrhage in the medullary portion of the bone. Thoma (quoted by Ivy and Curtis³) believed that the decomposition of the fibrin causes an irritation which leads to resorption of the cancellous portion of the bone with the formation of a cavity.

Occasionally a cystic cavity may be found in the mandible of a child or young adult who gives a history of trauma a few weeks previously. Usually there is a moderately painful swelling of the bone at the point

² Stafne, E. C. Possible Role of Retained Deciduous Roots in the Etiology of Cysts of the Jaw, *J. Am. Dent. A.* **24** 1488-1493 (Sept.) 1937.

³ Ivy, R. H., and Curtis, L. Hemorrhagic or Traumatic Cysts of the Mandible, *Surg., Gynec. & Obst.* **65** 640-643 (Nov.) 1937.

of injury. Roentgenologic examination reveals a cavity in the bone along the course of the inferior dental canal, with no apparent connection with the roots of the overlying teeth. It may be impossible, without exploration, to differentiate such a cavity from a cyst of dental origin, particularly if some of the overlying teeth are pulpless.

At operation, if the cavity is found to be unlined and if the contents present evidence of hemorrhage, traumatic origin of the cyst is highly probable. In more recent cysts blood may be evident grossly. Older cavities are likely to contain a straw-colored fluid, and the evidence of hemorrhage may consist only in the finding of microscopic evidence of degenerated blood and of cholesterol crystals.

Evacuation of the contents of the cavity usually is all that is necessary to bring about a cure.

CYSTS OF INDETERMINATE ORIGIN

In 4 cases in the present series a large cyst at the angle of the mandible was found to contain material like oatmeal gruel. This material was quite different from that encountered in any cysts elsewhere in the mandible. Three of these cysts had no lining and were unilocular, whereas the fourth was lined with squamous epithelium and was multilocular. The unlined cysts possibly were of traumatic origin and the multilocular epithelium-lined cyst may have originated as a follicular cyst, the explanation for the material in them, however, resembling "oatmeal gruel" remains uncertain.

There are no clinical or roentgenologic findings to differentiate these from other cysts. The findings at operation are so characteristic, however, as to justify a separate classification for the group.

The treatment need not differ from that for other benign cysts.

MEDIAN ANTERIOR MAXILLARY CYSTS

Recently, Stafne and his associates⁴ published an excellent historical summary and discussion of median anterior maxillary cysts, together with reports of 3 cases. Such cysts are of nondental origin and are situated in the region of the anterior palatine canal.

Meyer reported the first cyst of this type in 1914, it was found in a cadaver while median sections were being made. Although there were occasional reports of such cysts subsequently, their frequency was not appreciated until 1931, when Meyer⁵ published the results of a study of 600 cadavers. He found 1 such cyst in every 66 specimens. He also

4 Stafne, E. C., Austin, L. T., and Gardner, B. S. Median Anterior Maxillary Cysts, *J. Am. Dent. A.* **23** 801-809 (May) 1936.

5 Meyer, A. W. Median Anterior Maxillary Cysts, *J. Am. Dent. A.* **18** 1851-1877 (Oct.) 1931.

stated that on examination of roentgenograms he found what he considered to be good evidence of such a cyst once in 88 instances. Stafne and his associates¹ stated that they found good roentgenographic evidence of them once in each 100 dental roentgenograms. Formerly these cysts evidently were mistaken in dental roentgenograms for anomalies of the abnormally large anterior palatine fossae.

Meyer's⁵ belief that such cysts arise from epithelial remnants which persist in the nasopalatine closure appears well founded. In discussing the nasopalatine canals Schaeffer⁶ wrote

Approximately 2 cm dorsal to the inner margin of the nostril and in juxtaposition to the nasal septum each nasal fossa presents a slight depression in its floor. This depression leads into a small canal lined with mucosa prolonged from that which lines the inferior nasal meatus. This funnel-shaped tube of mucous membrane, the nasopalatine canal, courses obliquely caudal-ward and passes through the Y-shaped incisive foramen (anterior palatine canal) in the hard palate. The canals end on the roof of the mouth at the side of the palatine papilla or incisive pad.

The nasopalatine canals are remnants of the wide communication between the nasal and oral cavities found at an early period of fetal life. Occasionally in adult man they lead to a direct communication between the nasal fossa and the buccal cavity. In the majority of instances, however, the lining of the canals is obliterated and represented by impervious cords of epithelial cells continuous with the roof of the mouth at one extremity and with the funnel-shaped epithelial-lined depressions in the floor of the nasal fossae at the other.

From this excellent description of the nasopalatine canals it is easy to understand that a persistent canal or proliferation of portions of persistent epithelial cords might give rise to an epithelium-lined cyst. These cysts are found anteriorly in the middle of the upper jaw, just above or partially between the root tips of the upper central incisors. They seldom give rise to symptoms and usually are discovered in the course of routine dental roentgenographic examination. Stafne and his associates⁴ gave an excellent description of the normal roentgenographic appearance of this area and of its appearance when a cyst is present. The treatment is surgical, with removal of the lining of the cyst.

On microscopic examination the lining is found to consist of squamous, transitional or columnar epithelium, according to whether the cyst arose at the buccal extremity, at the midportion or at the nasal end of the canal or epithelial cord. In the group of cases under consideration there were 4 such cysts.

FACIAL CLEFT CYSTS

In the second month of fetal life there appear on either side of the nasofrontal process two ectodermal thickenings, the medial nasal process

6 Schaeffer, J. P. The Nose, Paranasal Sinuses, Nasolacrimal Passageways and Olfactory Organ in Man. A Genetic, Developmental, and Anatomico-Physiological Consideration, Philadelphia, P. Blakiston's Son & Co., 1920.

and the lateral nasal process. Between the two thickenings, on either side, is a depression, the future nasal vestibule. As development progresses, the two medial processes fuse to form a single median process, which eventually forms the middle portion of the upper lip and jaw and part of the nasal septum.⁷ The lateral nasal process forms the lateral wall and the ala of the nose. The fusion of the maxilla with the median and lateral processes completes the formation of the upper jaw and lip and the nose. Complete failure of closure results in harelip and cleft palate. Persistence of epithelial remnants in the line of closure undoubtedly may occur, and it is believed that these give rise to cysts in this region.

In the present series we encountered 21 cysts of this type. They are found under or just below the nasal ala. Frequently they elevate the floor of the nasal vestibule, sometimes sufficiently to interfere with breathing. They are not intraosseous but usually lie in a depression in the bone. Rarely, they are extensive, and a large cavity is found separating the maxilla from the premaxilla, sometimes extending well back along the floor of the nose, with involvement of the palate. Not infrequently a defect in the anteromesial wall of the antrum is found.

Microscopic examination of the cysts in the cases observed at the Mayo Clinic revealed a lining of squamous epithelium in 9 instances, of columnar epithelium in 3, of cuboidal epithelial cells in 1 and of fibrous inflammatory tissue in 8.

Treatment consists of removal of the lining, which usually is readily accomplished through an incision under the upper lip. Occasionally in cases in which the cyst elevates the floor of the nasal vestibule, it is impossible to separate the wall of the cyst from the skin of the floor of the nose, and a small portion of the latter must be removed. This has not been found to cause any trouble.

ADAMANTINOMAS

An adamantinoma of the jaw results when paradental embryonic epithelial remnants proliferate with little or no differentiation of the cells. McGregor⁸ stated the belief that the tumor sometimes may originate from gingival epithelium. Broders and MacCarty⁹ cited Buchteman and Kolaczek as stating that the adamantinoma may arise from the mucous membrane or from the mucous glands of the mouth. Broders¹⁰ recently said that he has seen 3 specimens which support the

7 Keith, A. *Human Embryology and Morphology*, ed. 5, Baltimore, William Wood & Company, 1933.

8 McGregor, L. *A Report of Eleven Instances of Adamantinoma with a Review of the Malignant Cases in the Literature*, *Acta radiol.* **16** 254-274, 1935.

9 Broders, A. C., and MacCarty, W. C. *Epithelioma*, *Surg., Gynec. & Obst.* **27** 141-151 (Aug.) 1918.

10 Broders, A. C. Personal communication to the author.

view that an adamantinoma may originate from the epithelium of the gum, he does not subscribe to the idea that it may originate from mucous glands

The adamantinoma is a malignant tumor made up of nests of cells in a stroma of normal connective tissue (fig 2 *A*) These masses of cells resemble in varying degree the epithelial structures present in the embryonic stage of development of the normal tooth Early, the tumor is solid, but cystic degeneration soon appears and gives it a characteristic multilocular cystic arrangement The tumor is slow growing and inactive Some pathologists believe it should be classified as a non-malignant neoplasm However, it grows uninterruptedly, it recurs persistently if incompletely removed, and it gives rise to metastasis¹¹ (fig 2 *B*) All these characteristics are clinical earmarks of a malignant tumor

The patient with an adamantinoma frequently describes only one symptom, namely, a slowly enlarging tumor of the jaw In the series of 58 cases observed at the Mayo Clinic this was the only symptom in 39 "Tumor with pain" was recorded in 11 cases, the pain being described as "slight" except with the more advanced tumors "Tumor and draining sinus" were recorded in 6 instances Drainage usually had followed extraction of teeth or an operation "Loosening of teeth and pain" were recorded as the outstanding symptoms in 1 case The symptoms were not recorded in 1 instance

Twenty-three of the patients were males, 35, females Their ages by decades on admission were as follows second decade, 1, third decade, 9 fourth decade, 16, fifth decade, 13, sixth decade, 12, and seventh decade, 7

The duration of the disease on admission ranged from six months to twenty-nine years In 38 instances the disease had been present from one to ten years and in 15 from eleven to twenty years In 3 instances the history dated back more than twenty-one years In 2 cases the duration of the disease was not known

Adamantinomas occur most commonly in the lower molar and bicuspid regions On the assumption that the tumor had originated at the approximate center of the area involved, in the cases in the present series, in which there was involvement of the lower jaw 26 tumors apparently originated in the molar-angle region, 21 in the bicuspid region and 5 in the incisor-cuspid region, 1, an extensive bilateral lesion, probably began in the central incisor area The tumor originated in the right side of the upper jaw in 1 instance and in the left side of the upper jaw in 4

11 Vorzimer, J, and Perla, D An Instance of Adamantinoma of the Jaw with Metastases to the Right Lung, *Am J Path* 8 445-454 (Jul) 1932

The diagnosis of an advanced adamantinoma may be suspected from the long history of a good-sized tumor of the jaw which has not



Fig 2 (case 1) —*A*, adamantinoma of the mandible *B*, metastatic adamantinoma in a submaxillary lymph node

invaded the soft tissues. Sometimes a crackling sensation can be elicited on palpation of prominent portions of the tumor, and sometimes there is a history of spontaneous or surgical drainage of straw-colored

fluid. Roentgenographically, the multilocular cystic arrangement of the bony shell and trabeculae is characteristic (fig 3 *A*). In the present series the diagnosis was confirmed by microscopic examination in 53 cases. It was made by roentgenologic examinations alone in 2 cases, by exploration alone in 2 and by clinical examination alone in 1 case, in which the condition was hopelessly advanced.

The treatment of adamantinoma, to be successful, must be surgical and must be radical. Because the growth of the tumor is slow, the temptation is to employ conservative measures, such as curettement, with or without chemical or thermal cauterization of the wound and perhaps combined with irradiation. Such methods of treatment have been widely used, and the percentage of failures has been high. This has been well shown by McFarland and Patterson,¹² who collected from the literature reports of 166 cases of adamantinoma of the jaws. In 90 of these reports, data were available regarding the progress of the patient

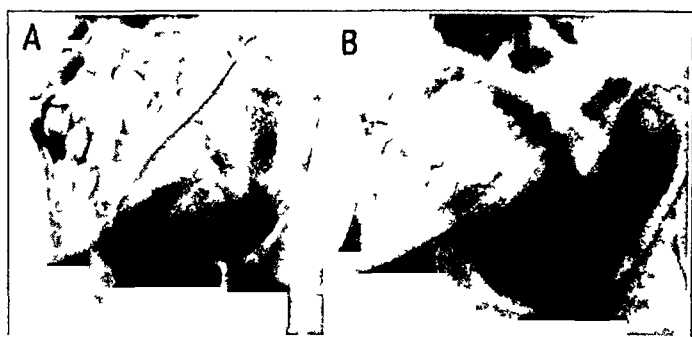


Fig 3 (case 1) —*A*, recurring adamantinoma. Note the thinness of the remaining portion of the ascending ramus. *B*, roentgenogram taken eight months after removal of the tumor by surgical diathermy. Note the increase in thickness of the remnant of the ascending ramus.

after treatment. There were 65 cases in which a variety of conservative methods had been employed, and in this group recurrence was reported in 33, a percentage of failure of 50.7. On the other hand, in the same series there were 25 cases in which resection of the mandible had been carried out. In this group 5 recurrences were reported and 1 post-operative death, a percentage of failure of only 24.

The reason for the high percentage of failures following the conservative types of treatment can be seen readily on examination of microscopic sections which include the outer portion of a tumor together with the adjacent shell of bone. In these, microscopic finger-like extensions of the tumor into the bone can be seen. Obviously curettement or any similar measure is likely to fail to remove all of them.

12 McFarland, J., and Patterson, H. M. Adamantinomata. A Review of One Hundred and Ninety-Six Cases Reported in the Medical and Dental Literature, *Dent Cosmos* 73: 656-670 (July) 1931.

In the earlier cases observed at the Mayo Clinic the conservative type of treatment usually was employed, and the results proved disappointing. As a result, my colleagues and I have come to employ surgical diathermy or resection exclusively. Of 20 patients so treated, we have been able to trace 19. Sixteen of them (84.2 per cent) have been free from recurrence for an average of six and one-fifth years.

In the use of surgical diathermy, the entire tumor is coagulated, and the surrounding bone is cauterized sufficiently to cause a sequestrum at least 5 mm in thickness. Tumors involving a considerable proportion of the thickness of the mandible can be removed in this way, leaving a bridge of normal bone. This bridge thickens appreciably during the two or three months required for separation of the sequestrum, and in many instances a surprisingly narrow remnant thickens sufficiently to maintain the contour and function of the jaw (fig 3 B).

If resection of the mandible is necessary, diathermy is admirably suited for this also. The mandible is exposed and severed anterior to the growth. The diathermy electrode is then applied to the cut end of the bone containing the tumor, and a strong current is used to raise the temperature of the bone until the periosteum is blanched and rendered friable. The soft tissues can then be separated from the heated portion of the bone with the finger and the charred bone cut away. This process is repeated as often as necessary to remove the desired portion of the mandible together with all the expansions made by the tumor. After exposure and section of the mandible, the operation is practically bloodless, so that the extensions of tumor can be identified and removed with a high degree of certainty.

The following report of a case illustrates three important points regarding adamantinoma of the jaw: (1) the failure of conservative treatment, (2) the development of metastatic adamantinoma¹³ and (3) the successful treatment of recurrence by means of surgical diathermy.

In June 1925 a married woman of 49 came for examination because of swelling of the right side of the lower jaw, which had been noted for several years and which was increasing. On examination a multilocular cystic tumor was found involving the posterior half of the body of the right side of the mandible and the lower half of the right ascending ramus. Two enlarged glands were palpable in the right submaxillary region.

¹³ In this series there was 1 other case in which metastasis occurred. The patient died. Another patient died elsewhere with a diagnosis of "tumor of the lung." This may have been a metastatic adamantinoma.

Since this paper was prepared I have seen an additional patient who had an adamantinoma of the jaw with metastasis of the submental and submaxillary nodes. The diagnosis was confirmed by microscopic examination of tissue both from the primary and from the metastatic nodes. There has been no recurrence after nine months.

On July 3, 1925, the tumor of the mandible was removed with the curet, along with the outer shell of bone covering it. Microscopic examination of the tissue removed revealed adamantinoma (fig 2 *A*). On July 16 the right submaxillary and upper cervical lymph nodes were removed. Microscopic examination of these excised nodes revealed adamantinoma (fig 2 *B*). Postoperatively roentgen and radium irradiation were employed.

The patient returned on Oct 12, 1927, and examination revealed a recurrence of the adamantinoma involving the posterior extremity of the right horizontal ramus and a large portion of the ascending ramus (fig 3 *A*). On October 26 the recurring tumor was widely destroyed with surgical diathermy (fig 3 *B*). At the time of the last examination, six years later, there was no evidence of recurrence of the adamantinoma, either in the jaw or in the lymph nodes of the neck. Nine and a half years later (in April 1937) the patient wrote that she was "enjoying the best of health."

SUMMARY

Most of the benign cysts of the jaws arise as a result of proliferation of dental embryonic rests. They are readily amenable to appropriate conservative treatment.

The adamantinoma, likewise, arises from dental embryonic rests. It, however, is a malignant tumor, and radical surgical treatment is required for its cure.

"FUNCTIONAL" LOSS OF HEARING FOLLOWING INJURIES TO THE HEAD

PRELIMINARY REPORT

MORRIS ROSENTHAL, M D

NEW YORK

From my experience in examining patients for loss of hearing following injuries to the head, I have come to the conclusion that there is not that constant association between such injuries and loss of hearing which is assumed in the literature on the subject

This is a preliminary report to determine the functional loss of hearing which follows trauma of the head of varying degrees

I am defining functional loss of hearing from an industrial angle. Assuming that ordinary conversation is carried on within the frequencies 256, 512, 1024 and 2048 double vibrations, I am basing my deduction on the loss in decibels for these frequencies and calling it functional loss. Sonnenschein¹ said

It is now known that voice sounds range from 200 to 3000 D V. If an individual can hear low tones below 200 D V and high tones above 3000 D V but cannot appreciate those frequencies lying within this range, he is unable to understand the spoken voice and is deaf for all practical purposes

In the following 19 cases the patients were examined at Gouverneur Hospital within a day or two after admission or as soon as they became oriented. The cases were not especially selected.

A 6-A Western Electric audiometer, with soft rubber on the air conduction device, was used. In some of the cases no masking device was used when bone conduction was being determined. In others the Western Electric masking device was used. When the power output of the masking device was not sufficient to permit the patient to signify the presence of bone conduction or when the electric masking device confused the patient, air masking was used. This was done by having the patient hold a rubber tube opposite the opening of the external auditory canal of the ear to be masked while air was blown into the tube.

The criteria that I have used to determine normal hearing are those established by Fowler and Fowler² in a paper read before the Ameri-

1 Sonnenschein, R, in Piersol, G W. Cyclopedia of Medicine, Philadelphia, F A Davis Company, 1932, vol 4, p 855

2 Fowler, E P, and Fowler, E P, Jr. Normal Hearing by Bone Conduction as Measured with an Audiometer, Ann Otol, Rhin & Laryng 45 754 (Sept) 1936

ican Otolological Society on May 28, 1936, in which standards for normal hearing for the decades from 10 to 80 years were set. This standard is in general accord with the findings of Drury,³ published in the *Archives of Otolaryngology*.

All patients recovered sufficiently to be discharged from the hospital.

REPORT OF CASES

CASE 1—M. C., a white man aged 49, met with an accident on Sept. 13, 1938. He was hit by a truck while walking and was dazed but not unconscious. He suffered laceration of the right side of the forehead just above the eyebrow. He had a dull headache, without vertigo, impairment of hearing or tinnitus. Neither ear drum showed hyperemia or trauma. The nose showed deviation of the septum to the left, with a bilateral mucopurulent discharge, the throat was normal. He gave a history of fracture of the nose twenty years previously. Cerumen was removed. A neurologic impression of cerebral concussion was recorded by Dr. Peterson.

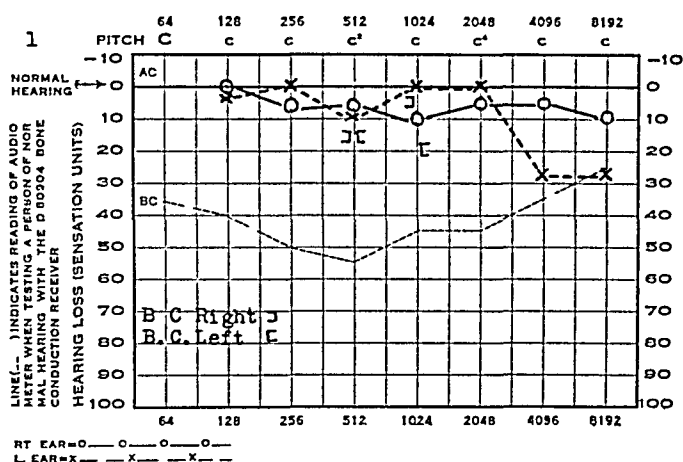


Chart 1 (case 1) —Audiogram made on Sept. 20, 1938. In this and the subsequent audiograms *B. C.* signifies bone conduction.

Roentgen examination did not show trauma of the skull. A spinal tap showed an initial tension of 13 mm of mercury and a terminal tension of 6 mm. The cell count was normal.

Bone conduction was determined without masking. Air conduction was functionally normal. Trauma in the basal coil of the cochlea on the left was probable, though the injury was on the right side.

CASE 2—G. A., a white youth aged 18, met with an accident on Sept. 18, 1938. He was tackled and thrown to the ground while playing football, he "was unconscious for five or ten minutes," then walked home, one-half block away, went to bed for about one hour and then sat around the house. He had a headache for the next eighteen hours. The next morning he felt dizzy and vomited about fifteen or twenty times. He was brought to the hospital. A trauma was not demonstrable. The past otorhinolaryngologic history was noncontributory. The ear drums were

3 Drury, D. W. Tests of Hearing of Five Hundred Average Ears by the Audiometer 2 A, *Arch. Otolaryng.* 1:524 (May) 1925.

normal except for slight congestion around the malleus on each side. The nose and throat did not show any pathologic change. A neurologic impression of cerebral concussion was recorded by Dr. Peterson twenty-four hours after the accident. Roentgenograms of the skull did not show fracture. A spinal tap showed an initial pressure of 6 mm of mercury and a terminal pressure of 4 mm. The cell count was normal.

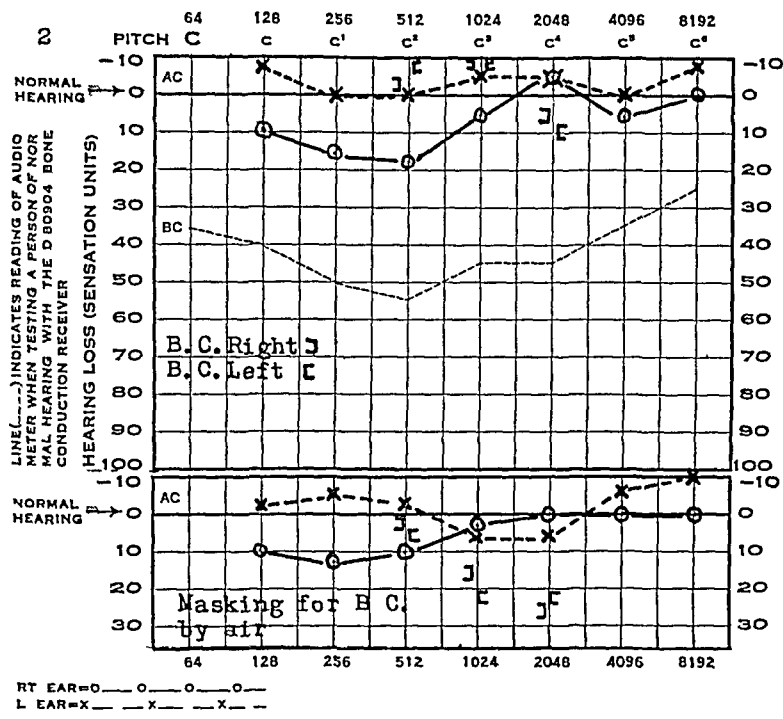


Chart 2 (case 2) —Above, audiogram made on Sept 20, 1938. Below, audiogram made on Dec 20, 1938.

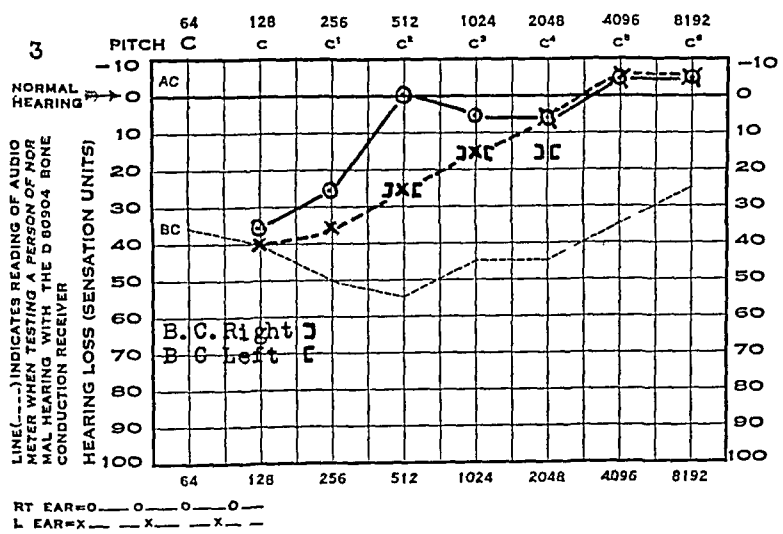


Chart 3 (case 3) —Audiogram made on Sept 18, 1938.

Bone conduction was determined without masking. Air conduction was within the average normal limits.

CASE 3—M. A., a white man aged 28, a fireman, met with an accident on Sept 17, 1938. As he was bending down, a newspaper roll fell on the back of his head.

He experienced a definite period of unconsciousness. On September 18 his symptoms were reported as a slight headache a few hours after the accident, without tinnitus or impairment of hearing. He gave a history of several operations for nasal polypi and treatment for sinusitis, the ears were normal. Neither drum showed trauma. A neurologic impression of cerebral concussion, with negative neurologic symptoms, was reported by Dr. Peterson. Roentgenograms did not show fracture of the skull. The cerebrospinal fluid was normal.

Bone conduction was determined without masking. Tests for air conduction showed loss for the lower frequencies due to the presence of polypi on the left and chronic sinusitis. Perception of the higher frequencies did not show trauma to the cochlea.

CASE 4—A. C., a white boy aged 9, met with an accident on Sept. 23, 1938. He fell on his head and right shoulder while skating, unconsciousness was questionable,

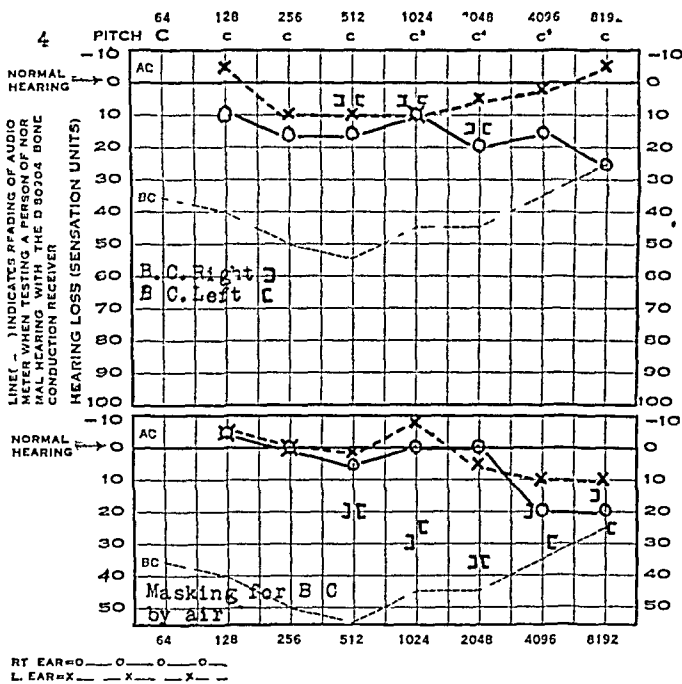


Chart 4 (case 4)—Above, audiogram made on Oct. 1, 1938. Below, audiogram made on Jan. 24, 1939.

he went home and complained of pain in the right shoulder and nausea, with persistent vomiting. He was brought to the hospital. There was no bleeding from the ears, nose or throat or evidence of trauma to the head. He complained of slight vertigo but not of loss of hearing. There was blood behind the right ear drum, with injection of the upper segment. Perception of C-11 was lateralized to the right. A neurologic impression of cerebral concussion and laceration into the right ear was reported by Dr. Peterson. The probability of fracture of the skull, suggested by Dr. Margaretten, was not confirmed roentgenologically.

Bone conduction was determined without masking. Tests for air conduction showed a loss on the right for the frequencies 2048, 4096 and 8192 and practically normal hearing for the lower frequencies. The loss was probably due to the bleeding behind the right drum.

CASE 5—S J, a white man aged 40, an ambulance driver, met with an accident on Sept 16, 1938. In a collision between the ambulance and a car he was thrown against the windshield, striking his head. He experienced a period of unconsciousness. He suffered slight abrasion on the bridge of the nose and fracture of a clavicle. On September 17 he did not have dizziness, tinnitus, impairment of hearing or vertigo. He had had furunculosis of the ears ten years previously. Both drums were slightly congested. A neurologic impression of cerebral concussion, without localized signs was reported by Dr Peterson. Roentgen examination did not show fracture of the skull. The spinal fluid was normal.

Bone conduction was determined without masking. Tests for air conduction showed impairment of not more than 5 decibels for the frequencies 1024 and 2048.

CASE 6—T V, a white man aged 53, met with an accident on Sept 25, 1938. He was found lying at the foot of stone steps in a cellar after having been drunk all the previous day, he had probably been lying in the cellar all night. He was

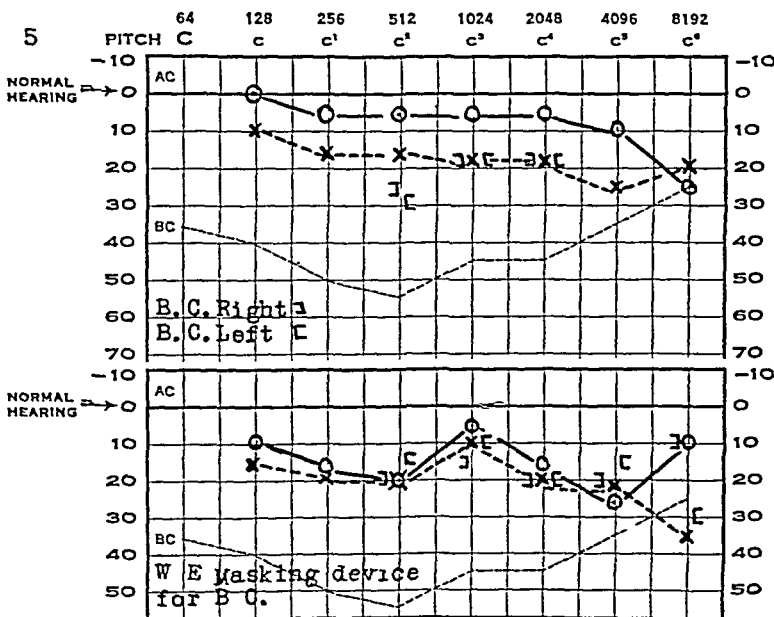


Chart 5 (case 5)—Above, audiogram made on Sept 20, 1938. Below, audiogram made on Jan 26, 1939.

bleeding from the left ear and from the skull on the left side. He experienced parietal and frontal headache on the left side, pain in the left ear, dizziness and bleeding from left ear, with partial loss of hearing on the left but no tinnitus in either ear. The eyes were normal, as was ocular motion, nystagmus was not present. The left ear drum was not visualized, because the canal was filled with wax and blood, but blood could be seen to ooze from the left ear. There was marked deviation of the nasal septum to the left. A neurologic examination indicating fracture of the base of the skull, concussion, contusion and possible laceration of the brain and contusion of the left parietal part of the scalp was reported by Dr Dappolonia. The patient had complained of earache on several occasions prior to the injury. Roentgen examination on October 6 showed multiple fractures of the skull and parietal regions. The spinal fluid was blood stained, with an initial pressure of 12 mm of mercury. The Wassermann reaction was negative.

Bone conduction was determined without masking. Tests for air conduction showed a loss for the higher frequencies, beginning with 1024 and 2048. This would indicate hemorrhages within the basal coil of the cochlea and a longitudinal fracture

CASE 7—J K, a white boy aged 8, met with an accident on Sept 25, 1938. He fell down a flight of stairs on the day before admission to the hospital, landing on his right collar bone, a history of unconsciousness was not elicited. He bled from the right ear. He did not experience vertigo or vomiting or complain of gross loss of hearing. He was not unconscious on admission, tenderness was present over the right parietal region. The right ear showed blood behind the drum, the left ear was normal. The neurologic status was normal, according to Dr. Peterson. Roentgenograms showed fracture of the skull and the right clavicle on September 26.

Bone conduction was determined without masking. There was marked loss of hearing by air conduction on the right, due to blood behind the right drum. Rec-

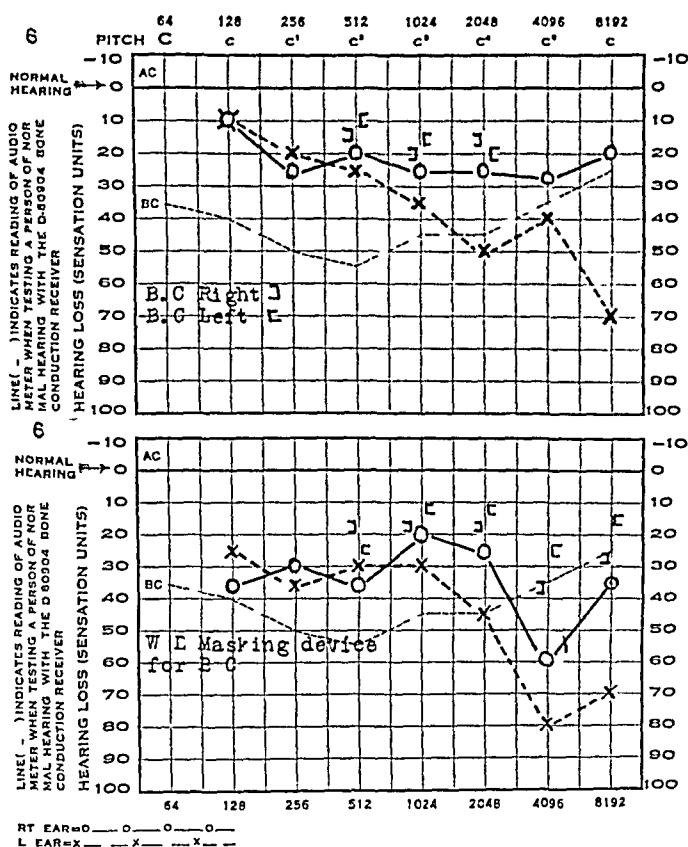


Chart 6 (case 6)—Above, audiogram made on Sept 25, 1938. Below, audiogram made on Jan 28, 1939. In this and the subsequent audiograms *W E* signifies Western Electric.

amination on December 22 showed the hearing within the normal range up to and including the frequency 4096 (C-5). The frequency 8192 (C-6) was heard at 35 decibels. With absorption of blood from the right middle ear, hearing returned to normal.

CASE 8—M M, a youth aged 16, met with an accident on Oct 1, 1938. Riding on a bicycle, he was hit by a police car and thrown into the air, he hit the windshield of the car and was then thrown to the ground, landing on his head. He was unconscious on admission to the hospital, he suffered laceration of the right parietal

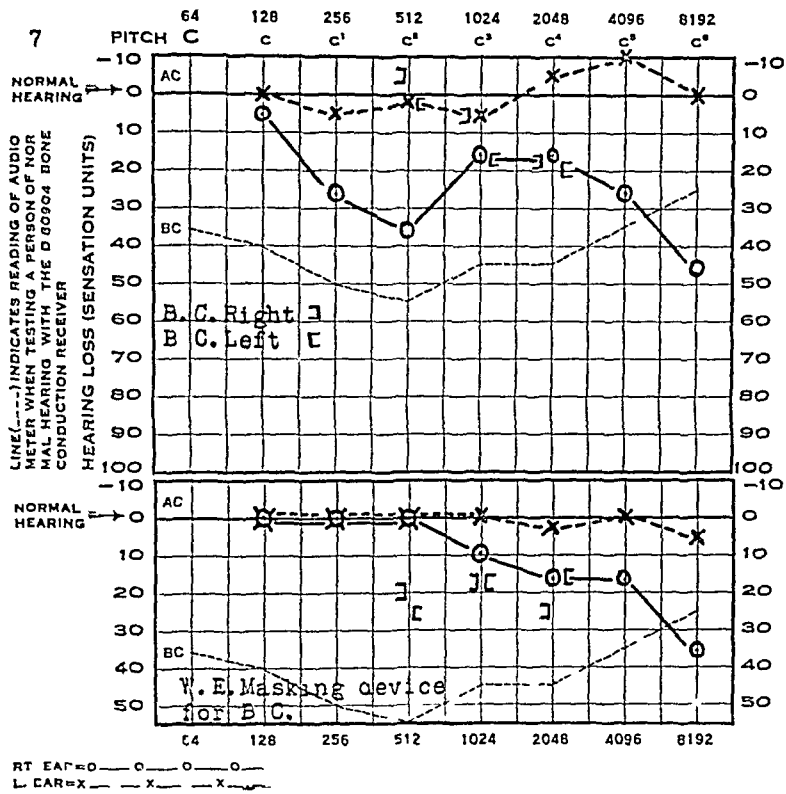


Chart 7 (case 7) —Above, audiogram made on Sept 26, 1938 Below, audiogram made on Dec 22, 1938

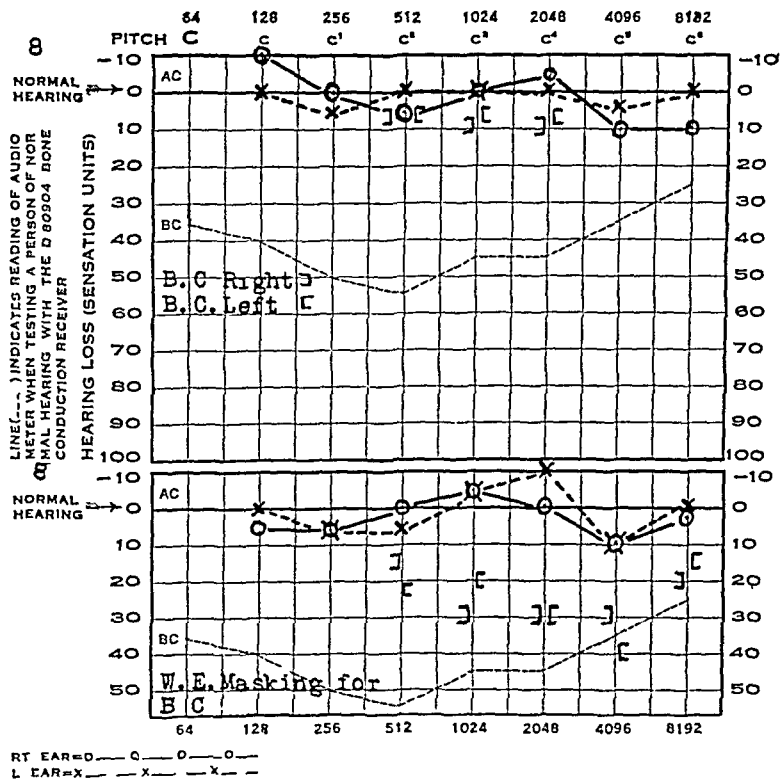


Chart 8 (case 8) —Above, audiogram made on Oct 2, 1938 Below, audiogram made on Jan 26, 1939

region, without bleeding from the ears or the mouth. One day after the accident he had headache, without vertigo, dizziness, impairment of hearing or tinnitus. The past otorhinolaryngologic history was noncontributory. Blood was present behind both drums. The neurologic impression was mild cerebral concussion. In roentgenograms taken on October 3 the skull did not show fracture. The spinal fluid was under an initial pressure of 16 mm of mercury, the appearance and cell count were normal.

Bone conduction was determined without masking. With blood in each middle ear, the hearing by air conduction was well within the normal limits. Evidence of trauma within the cochlea was not observed. Reexamination on October 14 showed an average increase of hearing for all frequencies of 10 decibels, due to absorption of blood from the middle ears.

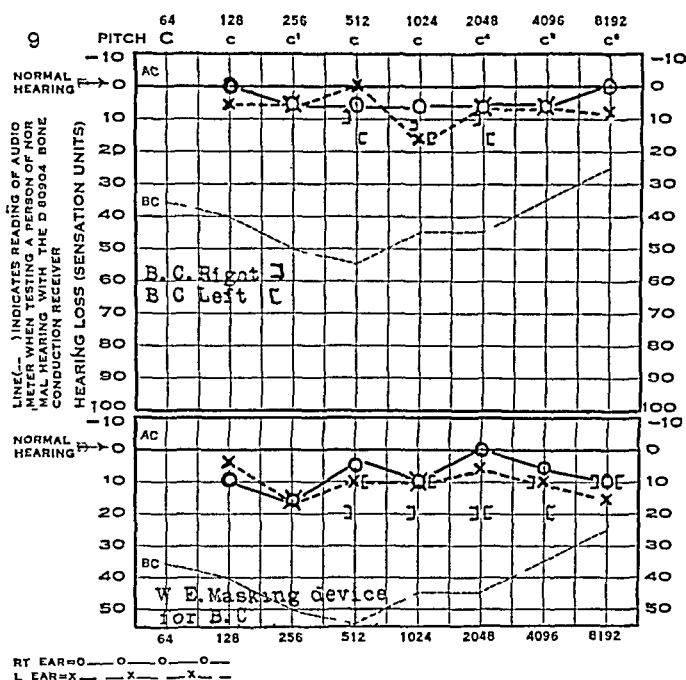


Chart 9 (case 9)—Above, audiogram made on Oct 21, 1938. Below, audiogram made on Jan 26, 1939.

CASE 9—C P, a white girl aged 5, met with an accident on Oct 10, 1938. She leaned over a rail on the third floor of a building and fell down a shaft, hitting her head, thigh and wrist in falling from side to side, she was not unconscious or dazed and did not show mental confusion or bleeding from the ears. She was rational, conscious and wide awake, without disturbance of speech or hearing. She suffered abrasions and hematoma over the left frontal part of the scalp. The ear drums did not show trauma. Neurologic examination indicated mild cerebral concussion. Roentgen examination on October 11 showed fracture of the skull and the left wrist. The spinal fluid was under an initial pressure of 6 mm of mercury, with a normal appearance.

Bone conduction was determined without masking. Air conduction was within the normal limits.

CASE 10—D J, a white boy aged 14, met with an accident on Oct 17, 1938. He was pushing a car and turning a corner when he was struck by a passing car, he was unconscious until brought to the hospital, there was no bleeding from natural orifices, nausea or vomiting. He suffered avulsion of the skin and deep fascia of the right leg and shock but was rational and did not experience disturbance of hearing. The ears, nose and throat were normal. The neurologic impression was mild cerebral concussion and shock. Roentgen examination on October 18 did not show fracture of the skull, fracture of the tibia was seen. The spinal fluid was under an initial tension of 12 mm of mercury and a terminal tension of 6 mm, otherwise it was normal.

Bone conduction was determined without masking. Air conduction was normal. Reexamination on Jan 24, 1939, showed a reading of zero for C-1, C-2 and C-3 and a drop of 5 decibels for C-4 and of 10 decibels for C-5 and C-6 on both sides.

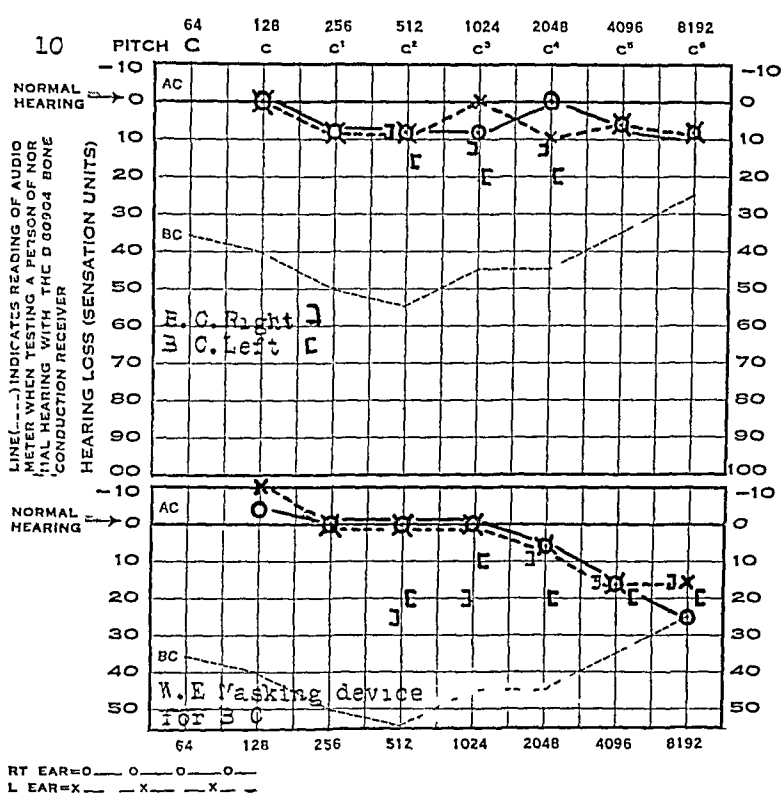


Chart 10 (case 10) —Above audiogram made on Oct 21, 1938. Below, audiogram made on Jan 24, 1939.

CASE 11—H J, a Negro aged 26, met with an accident on Oct 23, 1938. He was slugged from behind and was unconscious at the first blow, when he regained consciousness he went downtown in the subway. That night and the next day he had frontal headache and dizziness. He stayed in bed the next day and a half. He had experienced nausea and vomiting since the day after the accident. He came into the hospital from the outpatient department. He was lethargic and drowsy but conscious, his speech and responses were slow, he had not noted bleeding from natural orifices, tinnitus or loss of hearing. The right ear drum showed redness around the malleus, the left drum was normal. The nose and throat showed a profuse mucopurulent discharge. The neurologic impression was concussion and laceration of the cerebrum and subarachnoid and possibly subdural.

hemorrhage. Roentgenograms showed no abnormality. A spinal tap showed an initial tension of 6 mm of mercury and a terminal tension of 4 mm with bloody and xanthochromic fluid.

Bone conduction was determined without masking. Tests for air conduction showed a slight loss, of about 5 decibels, for C-1 and C-3 in both ears and a loss of about 15 decibels for C-5 and C-6 on the right side. The functional hearing was almost normal.

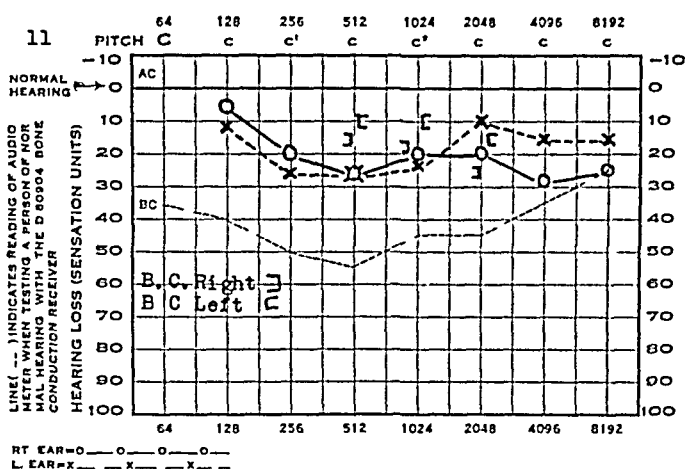


Chart 11 (case 11) —Audiogram made on Oct 27, 1938

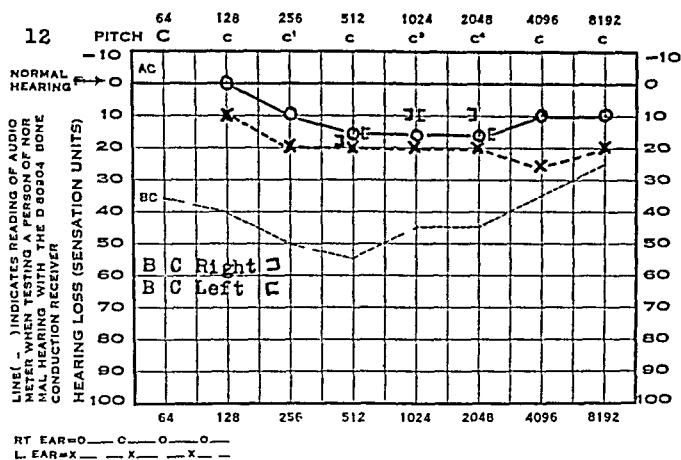


Chart 12 (case 12) —Audiogram made on Nov 5, 1938

CASE 12—W C, a Chinese man aged 35 met with an assault on Nov 4, 1938. He was attacked while asleep and hit over the head, back and arms with a steel knife sharpener. He stated that he "lost consciousness for several minutes." He did not experience vomiting, tinnitus or loss of hearing. He suffered laceration of the occipital region of the skull, possible laceration of the left kidney and contusion of the right arm. Both eardrums showed evidence of chronic catarrhal otitis media, without evidence of trauma. There was a postnasal mucoid discharge, the tonsils were diseased. The neurologic impression was cerebral concussion and possible fracture of the skull. Roentgen examination was not performed. A spinal tap showed an initial pressure of 8 mm of mercury, the fluid was clear.

Bone conduction was determined without masking. The functional hearing was practically normal. The slight loss that existed was probably due to pathologic changes in the nose and throat.

CASE 13—W I, a white man aged 53, met with an accident on Nov 4, 1938. While walking across the street he suddenly felt as if he had been blackjacked and then became unconscious. He was told that he had been hit by an automobile and had been unconscious about five minutes. Then he walked to the sidewalk and asked for help. He was brought to the hospital in an ambulance. He suffered laceration of the right frontal area, without bleeding from natural orifices, tinnitus or loss of hearing. The right ear drum was cloudy and slightly retracted, the left drum, markedly retracted, with congestion around the malleus. The nasal septum deviated to the left, occluding the lumen, which contained a mucopurulent discharge, a postnasal discharge was present. The neurologic impression was cerebral concussion and possible fracture of the skull. Spinal tap was refused by the patient. Roentgenograms did not show fracture of the skull.

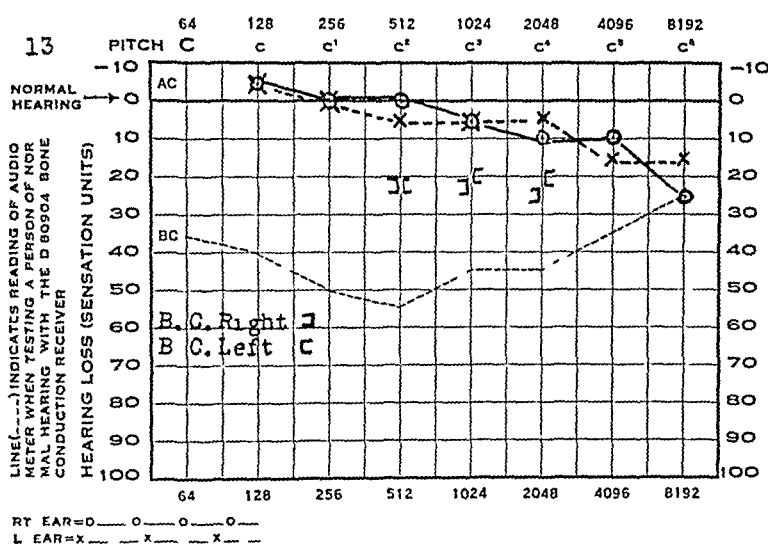


Chart 13 (case 13) —Audiogram made on Nov 9, 1938

Bone conduction was determined without masking. Air conduction was well within the normal limits. Functional loss of hearing was not observed.

CASE 14—D P, a white youth aged 19, met with an accident on Nov 9, 1938. He was assaulted by several men and knocked unconscious. He gave a history of impaired hearing on both sides due to chronic purulent otitis media, which was still present and was more marked on the right side. The right ear drum showed a large perforation, through which foul-smelling pus was discharging. The left drum was cloudy and retracted. A neurologic impression of cerebral concussion was reported by Dr Peterson. A spinal tap showed an initial pressure of 14 mm of mercury, which dropped to 12 mm after 3 cc had been withdrawn. The fluid was clear. By roentgen examination on November 14 no fracture of the skull could be seen.

Bone conduction was determined without masking. Tests for air conduction showed a definite loss, due to chronic purulent otitis media. The only possible traumatic loss might have been due to injury within the basal coil of the right cochlea, as indicated by an increase of 50 decibels in the perception of the frequency 8192 (C-6).

CASE 15—N I, a white woman aged 30, met with an accident on Nov 12, 1938. Standing on a sidewalk, she was hit by an automobile, she became unconscious and was found in that state by the ambulance surgeon, she regained consciousness in the hospital, she was bleeding from the nose and had a jagged laceration over the left eye. She had had an abscess in the left ear a number of years previously, which was incised and drained for a short time and left the hearing on the left side markedly impaired. The right ear drum showed slight retraction and congestion of

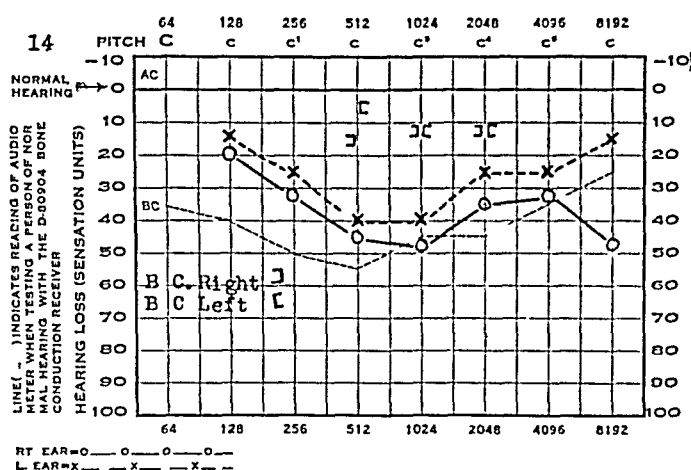


Chart 14 (case 14) —Audiogram made on Nov 15, 1938

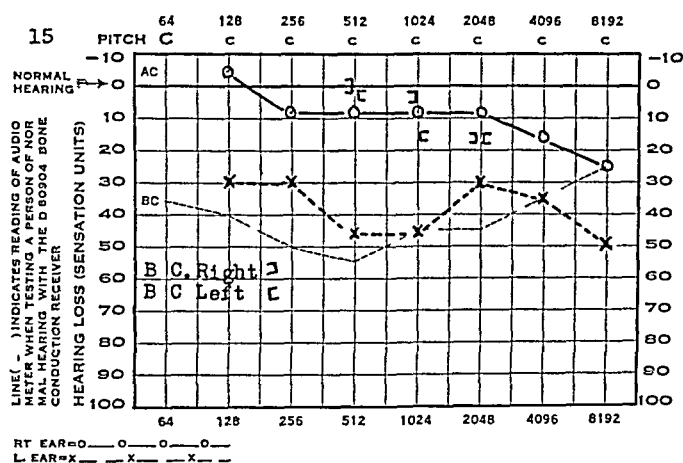


Chart 15 (case 15) —Audiogram made on Nov 16, 1938

the anterior segment. The left drum showed a large central perforation without any discharge. A neurologic impression of cerebral concussion and possible fracture of the skull was reported by Dr Dappolonia. The spinal fluid was bloody, with an initial pressure of 8 mm of mercury. Roentgen examination on November 14 showed a linear fracture involving the left vault of the frontal region, extending from the orbital ridge backward.

Bone conduction was determined without masking. Tests for air conduction on the left showed marked loss due to previous chronic purulent otitis media.

CASE 16—K B, a white woman aged 27, met with an accident on Dec 5, 1938. She was riding in the back seat of an automobile when it was struck from behind and she was thrown forward, striking her forehead and hip against the side of the car. She suffered laceration over the left eye and a transient period of unconsciousness. She did not note dizziness, vertigo, vomiting or impairment of hearing. The right ear drum was cloudy on the posterior segment, with slight reddening around the malleus. The left drum was cloudy over its entire extent and retracted. The nasal septum deviated to the right, the tonsils were submerged. The neurologic impression was cerebral concussion. The results of a spinal tap were negative. Roentgen examination did not show fracture of the skull.

Bone conduction was determined with a Western Electric masking device. Air conduction was well within the normal limits.

CASE 17—S L, a white boy aged 15½, was admitted to the hospital on Jan 1, 1939, after an accident on the same date. He gave a history of having been struck by a fist and knocked unconscious for a few minutes. On admission, one-half hour

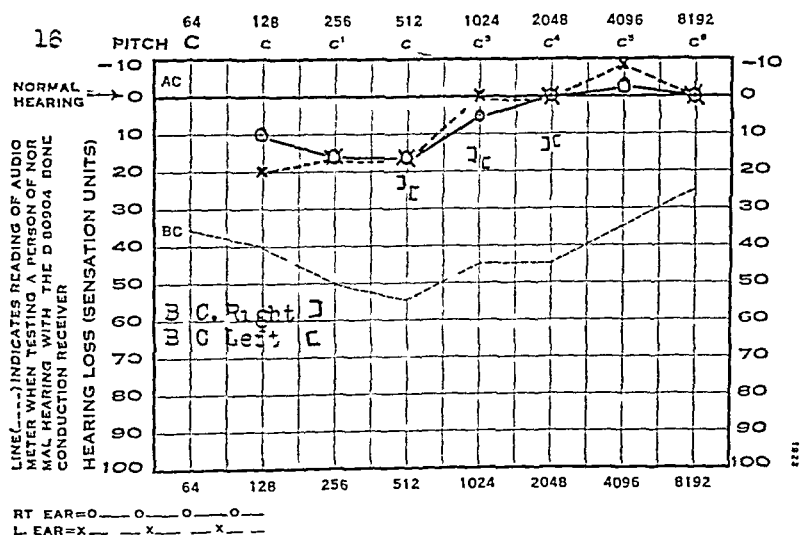


Chart 16 (case 16) —Audiogram made on Dec 8, 1938

after the accident, he was conscious and oriented, he bled from the right ear and the right nostril. He did not experience dizziness or buzzing or complain of loss of hearing. Examination showed subconjunctival hemorrhage in the lateral aspect of the right eye. Ecchymosis of the upper right eyelid and bleeding from the right ear and nostril also were present. The right auditory canal showed a fistulous opening from the posterior wall to the antrum, filled with clotted blood, and after this was wiped away there was a scanty foul-smelling discharge, blood clots were seen on the drum, the drum was irregularly adherent, perforation had not occurred. The patient gave a history of chronic purulent otitis media of several years' duration, with mastoidectomy performed on the right by the endaural method. The neurologic impression was negative. Roentgenograms did not show fracture of the skull. The spinal fluid was slightly bloody.

Bone conduction was determined with masking by air. Air conduction was well within the normal limits on both sides, despite previous chronic purulent otitis media on the right. There was a loss for C-5 and C-6 on both sides, probably due to trauma within the basal coil of the cochlea. The functional hearing was normal.

CASE 18—C H, a Negro aged 44, was admitted to the hospital on Dec 30, 1938 with a history of an attack of unconsciousness six days previously, which lasted several minutes. In April 1937 he had been struck over the left side of the head with a club and knocked unconscious, he had remained unconscious for about one month at the Harlem Hospital, where decompression and craniotomy were done, and had remained in the hospital forty days. After the injury he had had polyuria and polydipsia. Convulsions developed starting about August 1938. They were

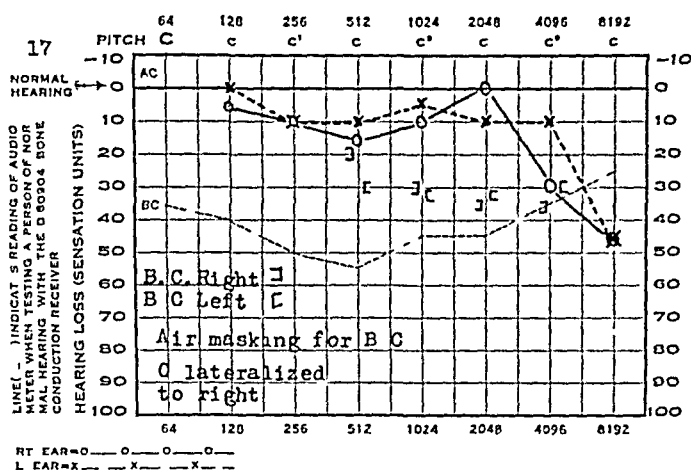


Chart 17 (case 17) —Audiogram made on Jan 3, 1939 C signifies perception for 128 double vibrations

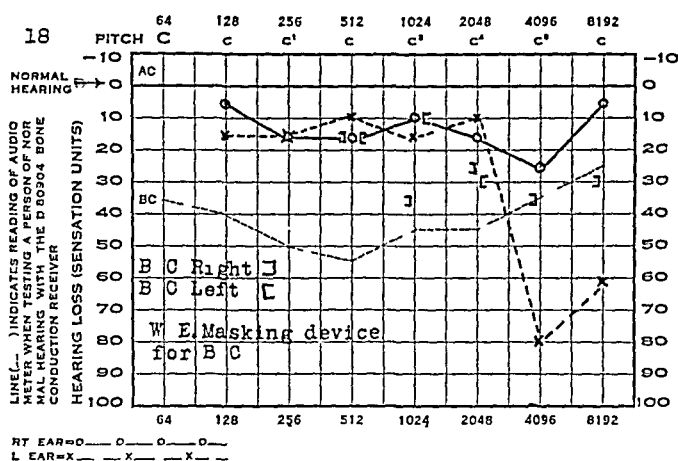


Chart 18 (case 18) —Audiogram made on Dec 31, 1938

not preceded by aura. He had had an attack six days previously, at which time he injured his head and elbow. Examination of the nose showed the septum deviated to the right, partly occluding the lumen, and a mucopurulent postnasal discharge. That of the ears showed the right drum retracted and cloudy, the left drum perforated at the anterior-inferior quadrant and no discharge. The neurologic impression was that the right pupil was slightly oval, rigid to light and slightly larger than the left and reacted slowly. The left pupil did not react to light, the field

of vision on both sides was somewhat contracted. The deep reflexes were all exaggerated, but the right abdominal reflexes were less so than the left. Romberg's sign was manifested as a tendency to sway to the left. A depression was noted over the left temporal area, the site of the previous operation. An encephalogram made on Jan 4, 1939, showed atrophy of the brain on the left side. The lateral ventricles were dilated, especially on the left, involving the anterior and lateral horns.

Bone conduction was determined with a Western Electric masking device. Tests for air conduction showed a marked drop for C-5 and C-6 on the left, due to trauma within the basal coil of the cochlea. The functional hearing was normal.

CASE 19—B. B., a white man aged 46, was admitted to the hospital on Jan 1, 1939, with a history of falling while cleaning windows on the fifth floor of a building. He tried to grab a projecting sign, after which he remembers nothing until he found himself in the hospital. The ambulance surgeon said "The patient was not unconscious when brought into the hospital but disoriented, blood flowed from the left ear but not from the nose or throat." At examination on January 21 the

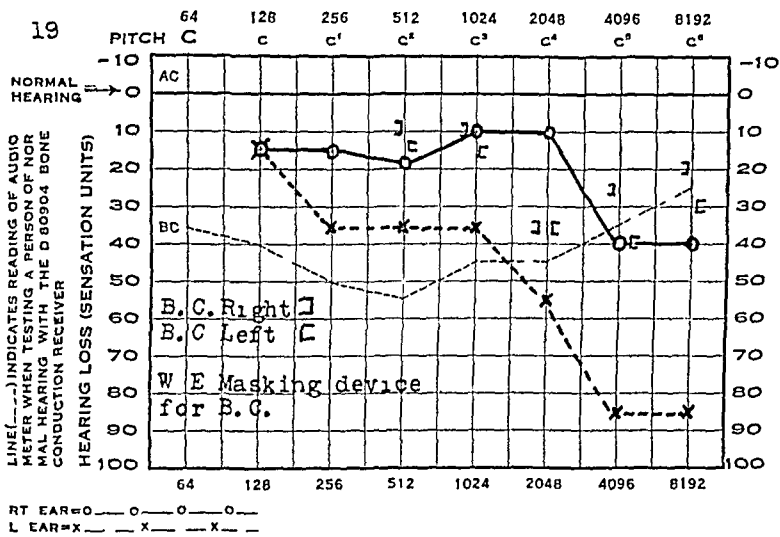


Chart 19 (case 19) —Audiogram made on Jan 21, 1939

patient said that he felt sick but not dizzy. Symptoms of vertigo were not present, spontaneous nystagmus did not occur, nor was vertigo elicited with the eyes at the extreme angle at each side, the patient did not complain of buzzing or loss of hearing. Slight deviation of the nasal septum to the right was noted, with pus in both sides. The throat contained a small amount of thick postnasal discharge, with thin streaks of blood. Both external auditory canals were filled with inspissated wax. The drum on each side was bluish (the middle ears contained blood), with congestion in the superior parts and around the malleolus on each side. The neurologic impression on Jan 18, 1939, was that the patient was semiconscious and lapsed into unconsciousness at times. He had suffered a laceration over the forehead which came down to the frontal groove, where there seemed to be a depression of the frontal bone, and over the left parietal and frontal region extending to the bone, with no evidence of fracture at that point. The pupils were irregular and reacted to light and in accommodation. There was a laceration at the extreme edge of the external angle of the right eye and over the bridge of the nose. The abdominal reflexes were present and active. The deep reflexes were present. Babinski's sign was absent. Blood was issuing from the left ear. The diagnosis was cerebral concussion and fractured skull.

COMMENT

A review of the cases gives data only partially in agreement with those obtained by other investigators. Shambaugh⁴ said, "I have never been convinced that a blow on the head can result in only a partial loss of hearing." Fletcher⁴ interpreted this remark to mean that there was either a total loss of hearing or none. Grove⁵ reported that in the examination of 42 patients with injuries to the head he discovered 31 with impairment of hearing. He cited Passow,⁶ saying that "in severe injuries to the skull, the ear practically never remains intact." Stenger⁷ noted that the temporal bone is involved in the heavy swinging movements incident to injury of the skull and that its contents must be thrown into violent commotion by the blow and thereby damaged. Ulrich⁸ reported on the microscopic examination of the temporal bone in 18 cases of basal fracture of the skull, and noted signs of injury to the cochlea in all cases. Grove⁵ concluded that the pathologic changes in human beings following injury to the head consist "of hemorrhages in various places, the site of predilection being the perilymph spaces in the basal coil of the cochlea." Theodore⁹ made postmortem observations on a man who had had injuries to the head twelve and twenty-two years before and reported degenerative changes, particularly in the cochlea. Barnick¹⁰ said that the loss of hearing for the high tones in cases of injury to the head with recovery is due to trauma of the basal coil of the cochlea. Bunch¹¹ concluded that

4 In discussion on Fletcher, H. A. Determination of Disability as to Loss of Hearing, and the Importance of Vertigo in Industrial Accident Cases, *J. A. M. A.* **79** 529 (Aug. 12) 1922.

5 Grove, W. E. Otologic Observations in Trauma of the Head. Clinical Study Based on Forty-Two Cases, *Arch. Otolaryng.* **8** 249 (Sept.) 1928.

6 Passow, A. Die Verletzungen des Gehörorgans, Wiesbaden, J. F. Bergmann, 1905, cited by Grove.⁵

7 Stenger. Ueber die Arten der nach Kopfverletzungen auftretenden Neurosen. Die traumatische Labyrinthneurose, *Deutsche med. Wchnschr.* **31** 63, 1905, cited by Grove.⁵

8 Ulrich. Klinische und anatomische Untersuchungen über Verletzungen des Gehörorgans bei Schädelfraktur, *Schweiz. med. Wchnschr.*, 1921, p. 24, cited by Grove.⁵

9 Theodore, E. Beitrag zur Pathologie der Labyrintherschütterung, *Ztschr. f. Ohrenh.* **61** 299, 1910, cited by Grove.⁵

10 Barnick, O. Ueber Brüche des Schädelgrundes, und die durch sie bedingten Blutungen in das Ohrlabyrinth, *Arch. f. Ohrenh.* **43** 23, 1897, cited by Grove.⁵

11 Bunch, C. C. Symposium. Neurol. Mechanism of Hearing, "Nerve Deafness" of Known Pathology or Etiology, Diagnosis of Occupational or Traumatic Deafness, Historical and Audiometric Study, *Laryngoscope* **47** 615 (Sept.) 1937.

when a dip occurs at 4096 double vibrations (C-5) acoustic trauma should be suspected. Linthicum and Rand¹² noted that in "functional" hearing tests made on 32 patients with injuries to the head only 6 failed to show some inner ear deafness. In the cases under review, there is to be noted a smaller percentage of involvement of the cochlea than in those reported in the literature just mentioned.

Unconsciousness and Labyrinthine Reactions—Grove⁵ noted unconsciousness in 29 cases. In my series there were 15 cases of unconsciousness. Labyrinthine reactions, either caloric or rotatory, could not be obtained on account of the condition of the patients, who as a result of their injuries were kept flat in bed. However, I attempted to observe the presence of labyrinthine involvement by questioning the patients as to vertigo and noting the presence or absence of spontaneous nystagmus. Symptoms of vertigo were found in 6 patients (cases 2, 4, 6, 11, 18 and 19). In no patient were these symptoms marked. Nystagmus was not noted in any of these patients. In this respect my findings differ from those of Grove,⁵ who reported nystagmus in 29 patients in his series, and of Brunner,¹³ who examined 60 patients with commotio cerebri and found nystagmus in 52. It is possible that transient nystagmus may have been present in my series, but, if so, it was not noted by the ambulance surgeon or the nurse in the accident ward, both of whom had been instructed to watch for this condition. The neurologists who examined the patients within twenty-four hours after their admission made no note of such a condition, nor did I find nystagmus in any of the patients when I examined them, within a few days after their admission, or as soon as they were oriented.

Bleeding from the Ears or Blood in the Middle Ear—Borden¹⁴ found bleeding in 221 of 408 cases. According to Grove,⁵ Phelps,¹⁵ who found bleeding in 285 of 1,000 cases, "held that hemorrhage from an ear is an absolutely diagnostic sign of a fracture of the temporal bone." Grove⁵ noted bleeding in 9 cases. This agrees with the findings in my series, in which 6 patients showed blood in the ears (cases 4, 6, 7, 8, 17 and 19).

12 Linthicum, F. H., and Rand, C. W. Neuro-Otological Observations in Concussion of the Brain, *Arch Otolaryng* **13**:785 (June) 1931.

13 Brunner, H. Pathologie und Klinik der Erkrankungen des Innenohres nach stumpfen Schädeltraumen, *Monatschr f Ohrenh* **59** 697, 1925, cited by Grove.⁵

14 Borden, C. R. C. Otologic and Rhinologic Complications of Skull Fracture, *J. A. M. A.* **53** 429 (Aug 7) 1909, cited by Grove.⁵

15 Phelps, C. An Analytical Review of One Thousand Cases of Head Injuries, *Ann Surg* **49** 449, 1902, cited by Grove.⁵

A second audiogram in case 4, taken four months after the initial examination, showed that with the absorption of blood from the right middle ear the hearing for the middle frequencies, from 256 to 2048 double vibrations, inclusive, was improved more than 10 decibels, although there was not much loss of hearing at the time of the accident. However, the hearing for 4096 and 8192 double vibrations was not improved on the right and had decreased on the left. This might be interpreted as being due to permanent trauma in the basal coil of the cochlea on the right in a limited area and possibly a delayed hemorrhage in the basal coil of the cochlea on the left. A more marked decrease in the impairment of hearing is to be noted in case 7. In view of the accepted theory that there can be no regeneration in the organ of Corti, the diminution in the loss of hearing for 4096 and 8192 double vibrations must be due to absorption of the blood within the cochlea. The presence of blood behind both drums in case 8 did not cause any complaint of loss of hearing on either side, although its absorption three weeks later caused an increase in the auditory threshold for 1024 and 2048 double vibrations, but the dip at 4096 double vibrations remained. The complaint of loss of hearing does not seem to have any positive significance. In Grove's⁵ series of 42 cases, 14 such complaints were made, although on examination he discovered permanent deafness in 31 cases. In my series of 19 cases, only 1 complaint of impaired hearing was made, although several of the patients had hard wax in the ears and some had blood in the middle ear. If one is to explain the absence of any complaint of loss of hearing in the patients who had wax in the ears by the slowness of the process of accretion, then how is one to account for the lack of complaint of impairment of hearing in cases in which the middle ear is suddenly filled with blood? Some of my patients who had blood in the middle ear but did not complain of impaired hearing showed on audiometer tests made several months later an improvement in the threshold of hearing of from 10 to 15 decibels.

Tinnitus—In the series of cases that I am presenting, there was no complaint of tinnitus lasting an appreciable time after the injury. In contradistinction to these findings, Grove⁵ reported 7 cases of tinnitus in his series, and Brunner¹³ noted the presence of tinnitus in 34 of 60 cases.

Loss of Hearing—In all the cases reported by various observers, a loss of hearing was assumed to exist whenever there was a drop from the threshold of perception for any frequency over the entire tonal range. Grove⁵ cited 12 cases which he classified as instances of loss of hearing in which there was a drop at 4096 double vibrations only.

although he said that these persons would not ordinarily be considered to have any loss of hearing

Linthicum and Rand¹² did not note the degree of loss of hearing in any frequencies in their series of 32 cases, but merely stated that hearing was abnormal or that abnormality in hearing was not present Bunch,¹¹ who gave the audiometer readings of 9 patients who had been exposed to the noise of the explosion of small arms, noted on page 640 that subjects 1, 2, 3, 5 and 8 were not aware of loss of hearing because the loss was above the range of the spoken voice, that is, above 2048 double vibrations, and concluded "Tests with a set of tuning forks which did not contain a C-5 (4,096 dv) fork would reveal losses in but a very few [cases]" In my series of 19 cases there are 3 (cases 6, 7 and 19) in which a definite loss of hearing after the accident was demonstrated by the audiometer In 1 of these (case 7) the hearing improved after the absorption of blood from the middle ear In case 15 there was unilateral loss of hearing on the left due to previously existing chronic purulent otitis media, but the loss for the higher frequencies may have been due to trauma within the basal coil of the cochlea resulting from the accident This patient registered no impairment of hearing on the left In case 14 there was bilateral loss of hearing due to a long-standing otitis media However, divergence of hearing for 8192 double vibrations on both sides is to be noted, the drop on the right being due to trauma In case 19 a test has not been made since the original examination, and no deduction can be made There are in this series only 2 cases in which the loss of hearing can be demonstrated, and both are cases of extremely severe injury, with fracture at the base

SUMMARY

Nineteen cases, with audiometer charts, are presented

Concussion was diagnosed by the neurologist in all cases

Unconsciousness was noted in 15 cases

Fracture of the skull was shown roentgenographically in 5 cases

The patient complained of vertigo (nausea, vomiting and dizziness) in 6 cases

Nystagmus was not noted in any case

Tinnitus after the first day was not noted in any case

Blood was seen in the middle ear in 6 cases

Loss of hearing for the higher frequencies was noted in 9 cases, in 3 of which it was bilateral

Loss of hearing within the "functional" range was noted in 2 cases, in both of which it was unilateral

CONCLUSION

A review of the cases presented suggests that impairment of hearing does not follow injuries to the head as commonly as is generally accepted, but that the trauma most often occurs in the basal coil of the cochlea with impairment for perception of the higher frequencies, above 2048 double vibrations, which does not, by itself, produce "functional" loss of hearing

Case Reports

DEFORMING AND RECURRING POLYPS OF YOUTH

HERMAN I LAFF, M D, DENVER

The finding of nasal polyps is common and ordinarily does not provoke unusual interest in the rhinologist. He expects to encounter them frequently in allergic and vasomotor nasal disturbances and in some types of suppurative nasal disease, especially ethmoiditis. Less often he finds them in association with malignant growths of the nose and sinuses, nasopharyngeal fibromas, syphilis, lupus and foreign bodies. He recognizes the etiologic relation of a solitary choanal polyp to diseased antial mucous membrane.

Experience, moreover, has taught him that nasal polyposis is almost exclusively a disease of adult life, except the choanal form, which not infrequently occurs in children. The finding of extensive multiple polyps in childhood would in itself be unusual, but its association with extreme external nasal deformity should stamp the case as worthy of study. This impression gains strength in view of the surprisingly few references to the syndrome in the literature.

Covili-Faggioli¹ credited Canuyt and Terracol² with being the first, in 1923, to describe the symptom complex which the latter termed "deforming and recurring polyps of youth." A search through the *Quarterly Cumulative Index Medicus* since 1917 has failed to reveal any reference to this entity in the American literature. Most of the relatively few references available are either to French or to Italian sources.

I have recently had a boy under my care with the most extreme polyposis I have ever seen, associated with a markedly disfiguring nasal deformity, which I undertook to correct by plastic repair after removal of the polyps.

REPORT OF A CASE

A P., a boy aged 15, referred by Dr. I. Girsh, came to my office on Dec. 22, 1936, complaining of asthma, difficulty in nasal breathing and external deformity of the nose. He had had nasal trouble and asthma since he was 7 years of age, the onset following a cold. He had had polyps removed from his nose by other physicians on four different occasions, but with only temporary relief. The polyps were first removed at the age of 9. The asthmatic attacks occurred throughout the year. Allergic tests followed by dietary regimens had not been of much help in controlling the asthma. For the past few months the growths had been seen protruding from each nostril. The father, mother and 2 brothers are living and well. The maternal grandfather was said to have had asthma. Wassermann tests of the patient and each parent were reported negative.

1 Covili-Faggioli, G. Deforming and Recurring Nasal Polyps in a Boy of Thirteen, *Boll. d. mal. d. orecchio, d. gola, d. naso* **53**:346 (July) 1935.

2 Canuyt, G., and Terracol, J. Deforming and Recurring Nasal Polyps of Youth, *Arch. internat. de laryng.* **30** 143 (June) 1924.

Examination revealed an enormous distention of the nose, producing disfigurement of both bony and cartilaginous portions. The nasal bones were separated at the dorsum, with flattening of the bridge. The ascending processes of the superior maxillas were flared outwardly. The cartilaginous framework of the nose was equally distended. This, together with the bony protrusions, produced an unnatural



Fig 1—Left, photograph of the patient before the operations showing the deformity of the nasal pyramid. Right, photograph of the patient after the removal of the polyps and the nasal plastic repair.

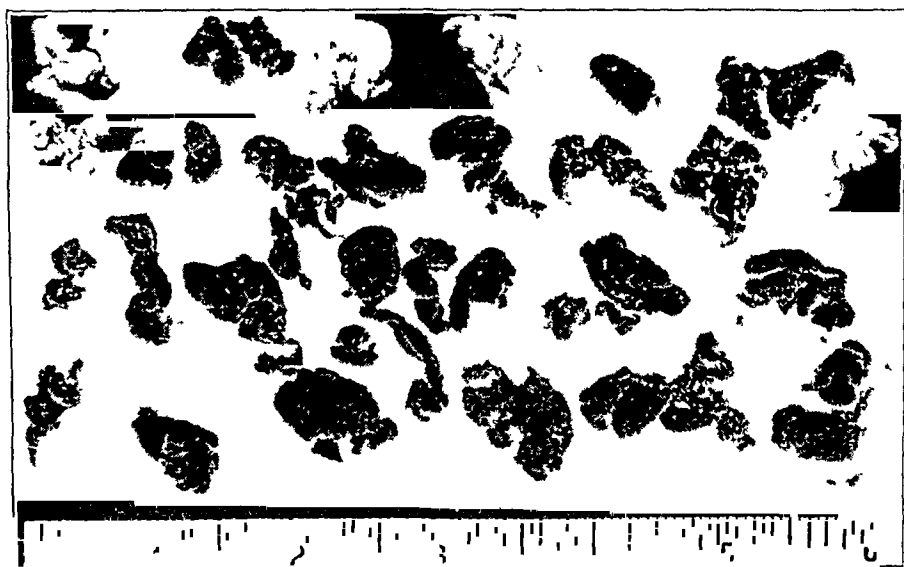


Fig 2—Photograph of the polyps removed from both sides of the nose, not including the polypoid masses removed from the ethmoid sinuses, which were almost equal to those illustrated.

and grotesque appearance (fig 1 A). The interior of the nose was filled with closely packed masses of polypoid tissue, protruding and visible at the external nares. The growths were also seen extending into the choanae. The chest was barrel shaped and emphysematous. Extreme kyphosis and pigeon breast with prominent costochondral junctions were noted.

The nose was freed of polyps after three sittings, with the area under cocaine mud anesthesia, which was necessary on account of their enormous number and marked tendency to bleed

After the nasal cavities had been cleared the patient was hospitalized, and bilateral ethmoidectomy performed. At that time masses of edematous tissue from the ethmoid labyrinths, at least equal in amount to the previously removed material, were everted.

It was hoped that the nasal configuration would in time alter and recede to more natural proportions, but after seven months little or no improvement could be detected. I therefore decided to narrow the nose by a plastic procedure similar to that employed in the commonly performed intranasal rhinoplasty. Utilizing the intranasal incision on each side, I elevated the skin and periosteum overlying the nasal bridge, sawed through each ascending process and approximated the fragments, thus narrowing the nasal bridge. Comparison of the photographs taken before and after operation show the improvement obtained (fig 1).

Nasal polyps are seldom found in the young. Thomson³ quoted Lacoarret, who found them in only 6 of 10,000 patients, the youngest being 6½ years old. The solitary choanal polyp, on the other hand, is said to be more common in patients under 20 years of age.

No longer considered an example of a myxomatous tumor or an edematous fibroma, the nasal polyp is now generally regarded as produced by long continued edema of the nasal and sinusal mucous membranes. Especially in the case of polyps arising from the ethmoid labyrinth, discussion regarding pathogenesis used to center around the part played by the underlying bone. There were those who described the process as "necrosing ethmoiditis," believing it to be a disease originating in the bone, while others maintained that the changes in the adjacent bone could be explained as secondary to the primary alterations in the mucous membrane (rarefying ethmoiditis).

In 1923 Canuyl and Teriacol,² at the French Congress of Otorhinology, described their experience with the symptom complex of polyps occurring in the young, under the heading of "Deforming and Recurring Polyps of Youth." They found as characteristic symptoms (1) generalized polyposis of both middle meatuses, (2) necrosing ethmoiditis, (3) deformity of the bony nasal pyramid and (4) recurrences in spite of intervention.

Covili-Faggioli¹ in 1935 reviewed this subject and added a case report of his own. In this contribution he cited reports by various authors but included among other types many references to juvenile nasal polyposis caused by congenital syphilis. In most of these, deformity of the nasal pyramid did not exist. Only the following citations in his article appear to fall into the category under discussion, i. e., recurring nasal polyps in the young producing facial disfigurement.

Ferraris⁴ in 1928 reported on 2 patients whom he had treated for polyposis and external nasal deformity, one a boy of 12 years and the other a boy of 18, for both of whom the Wassermann tests were negative.

3 Thomson, St. C. Diseases of Nose and Throat, ed 4, New York, D Appleton-Century Company, Inc., 1937, p 187.

4 Ferraris, G. Symptoms and Diagnosis of Deforming and Recurring Polyps of Adolescence, *Ann di laring, otol* 29 266 (Sept.) 1928.

Fotiade⁵ in 1928 reported the case of a boy of 14 with multiple recurring polyps destroying almost the entire nasal septum. The extent of external deformity, if any, was not mentioned. The Wassermann test was negative.

Aloi⁶ in 1929 described a youth presenting this symptom complex and referred to the procedure adopted in improving the external nasal deformity.

Leroux⁷ in 1930 related his experience with a youth who in addition to the polyps and deformity of the nasal bones presented bilateral exophthalmos. The Wassermann test was negative.

Regarding my patient, it appears that asthma played a definite etiologic role, since he had manifested symptoms of the disease since he was 7 years of age. At the time of writing he still has paroxysms requiring epinephrine for relief. I am of the opinion that the polyps originated as the result of a long-continued swelling of the nasal mucous membranes associated with the asthma, a point of view which coincides with that generally held today on the ordinary types of nasal and bronchial allergy. One need not assume a primary disease of the bone such as is implied by the term necrosing ethmoiditis.

When polyps commence at such an early age and in the presence of an exceptionally severe edematous reaction, they undoubtedly exert a powerful expanding pressure on the relatively soft and yielding nasal framework. This, together with the fact that the sutures between the various bones in this region are not firmly united, results in bizarre deformity.

Congenital syphilis as a chief cause of the condition is an assumption that hardly seems tenable, in view of the relatively few instances in which it could be proved in the cases cited in the literature. The relation appears to exist chiefly by virtue of the fact that in congenital syphilis edema of the nasal mucous membrane with consequent formation of polyps also is apt to occur in the young.

In contradistinction to the findings in this patient it is interesting to compare what Duke⁸ in 1930 described as a typical deformity of the bones of the face caused by perennial nasal allergy in childhood.

This was said to consist of a depression and flattening on each side of the nose probably caused by inadequate development of the ethmoid cells and antrums. Duke stated the belief that this lack of normal development was due to prolonged interference with the normal ventilation of the sinuses from narrowing and closure of their ostiums by the edematous membranes.

The deformity is unlike that caused by enlarged adenoids and mouth breathing. The earliest sign is a depression on each side of the nose near the inner canthi, followed later by similar depressions over the adjacent ascending processes and antrums. This results in undue prominence of the zygomatic arches—a common observation in asthmatic adults.

5 Fotiade, cited by Covili-Faggioli¹

6 Aloi, V. Deforming Polyposis of Nasal Fossae. Surgical Treatment, Two Cases, *Riforma med* 45 373 (March 16) 1929.

7 Leroux, cited by Covili-Faggioli¹

8 Duke, W. W. Deformity of the Face Caused by Nasal Allergy in Childhood, *Arch Otolaryng* 12 493 (Oct) 1930.

Duke stated the belief that the type of facies he described may make its appearance in a child within a year of the time of onset of perennial nasal allergy and can be relieved in a similar time if the allergy is completely controlled. He said that it remains permanently if carried over into adult life. He expressed the belief that seasonal allergy per se is not capable of producing such a deformity. In his opinion its association with asthma is common and "should indicate to the physician that nasal allergy probably does exist."

My patient presented symptoms of undoubted perennial nasal allergy from early childhood yet acquired a deformity quite different from that usually found. Since polyposis in early life is rare, the exceptions described by Duke are also uncommon. It is, of course, obvious why extreme polyposis by mechanical pressure will erase the typical deformity that Duke mentioned and in its stead produce swelling in the very parts that would otherwise appear depressed. For the same reasons, the infantile sinuses which should exist according to Duke's conceptions, become enormously distended.

The number of polyps removed in this case was larger than I have ever experienced, nor have I ever seen these growths produce such extreme external deformity of the nose.

The plastic procedure was undertaken not only for cosmetic reasons but in an attempt to obtain narrowing of the distended nasal fossae which remained after operation.

As was to be expected the polyps have recurred and have been removed since the nasal plastic procedure. It is hoped that by eradicating them before they have multiplied in such quantities as to produce symptoms of pressure recurrence of external deformity will be prevented.

CONCLUSIONS

An unusual case of extreme nasal polyposis with external facial deformity in an asthmatic youth has been presented.

This symptom complex has been described in foreign literature since 1923 but apparently has found but little or no mention in American periodicals.

It is believed that the deformity occurs from the effect of gradual pressure of the polypoid masses on the developing nasal walls and that so-called necrotizing ethmoiditis and congenital syphilis do not necessarily produce it.

It is important that polyps occurring in childhood be removed early and subsequently if necessary in order to prevent facial deformity.

Facial deformity may be improved by the usual intranasal rhinoplastic repair. Maintenance of the cosmetic result will depend on the adequate control of the recurring polyps.

Progress in Otolaryngology

Summaries of the Bibliographic Material Available in the
Field of Otolaryngology

PURULENT OTITIS MEDIA, MASTOIDITIS, SINUS THROMBOSIS AND SUPPURATION OF THE PETROUS PYRAMID

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NEW YORK

In the survey of the year's literature there appears a change in the trend of research reported. In this country particularly and in the Scandinavian countries also, otologists are primarily concerned with specific otologic problems which are as yet unsolved. The reports seem less concerned with the general topic of infections in the tympanomastoid area than with a search for solutions of definite problems created by infection. Only in the Russian and German literature are reports recorded of new local remedies for acute suppurative otitis. Knowledge of suppuration of the petrous pyramid is becoming, so to say, stabilized. Less rigid adherence to procedures routinely advocated is generally noted. It is indeed gratifying to record from both at home and abroad that a better comprehension both of the general symptoms and of the specific signs and symptoms which permit definite localization of the lesion is apparent. The general term "petrositis" is being supplanted by distinct localizing designations. There is evident also a mounting record of recoveries. In a study of the literature it is noteworthy that the popular laissez-faire attitude of a few years ago has definitely passed. Hardly any stress is placed on the contention that almost all petrosal suppurations cure themselves spontaneously. Some still do, as they always did. What is realized now as never before is that when a given suppuration does not tend toward spontaneous recovery adequate surgical intervention is indicated. The stress placed on this by the pioneer workers in the field has been fruitful in saving many otherwise lost lives. No better general commentary on the changed attitude is needed than the words of Dr. Joseph C. Beck¹ when, during the discussion of a symposium on

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1 In discussion on Lindsay, J. R. Suppuration of the Petrous Pyramid, *Arch Otolaryng* 27:652 (May) 1938

petrositis before the Chicago Laryngological and Otological Society, he said, among other things,

when this work on the petrous pyramid was first brought out and surgical intervention enthusiastically spoken of, I was unhappy about the whole thing and said to myself, "Now we will have a holocaust of deaths from this enthusiasm" After going through the literature and checking the cases reported, including 2 cases in which operation was successfully performed by my associate, Dr M R Guttman, I am glad to say that I have lived long enough to change my mind

The basic clinical picture of petrosal suppuration is so generally comprehended now by most clinicians that the variations from the classic symptoms have become the object of study and an evaluation of atypical symptoms is in progress

A more scientific approach is noticeable in the consideration and discussion of advocated surgical technics, with less importance attributed to the "conservative attitude" and more insistence on "adequacy" of the technic to reach and eradicate the lesion Finally, a sincere effort is evident to employ "the minimal amount" of surgical treatment to accomplish desirable ends, rather than to do routine surgical interventions and employ the same procedure in every case which presents itself, irrespective of its rationale

The use of sulfanilamide in the treatment of otologic conditions, excluding meningeal infection and sinus thrombosis, is so recent that at this time a proper discussion and evaluation is impossible Reports are only beginning to appear in the literature, and otologic clinicians are as yet unable to give specific reports and recommendations regarding the use of sulfanilamide in the treatment of suppurations involving various parts of the temporal bone Only a meager experience with chemotherapy in cases of thrombosis of the lateral sinus has changed the entire views of Cody² on this topic He cites Kemler³ to the effect that the symptoms of septicemia before operation are completely controlled during the administration of sulfanilamide and for five to seven days after its use but that chills and fever then recur For meningeal invasions and infections, the drug has given me, as well as others, excellent results, which, in my experience, are more prompt and effective when the focus in the temporal bone is eradicated promptly and efficiently by surgical intervention

² Cody, C C Thrombosis of the Lateral Sinus, *Tr Am Laryng, Rhin & Otol Soc* **44** 362, 1938

³ Kemler, J I, in discussion on Ersner, M S, and Myers, D Treatment of Thrombosis of the Lateral Sinus Without Ligation of the Internal Jugular Vein, *J A M A* **109** 923 (Sept 18) 1937

An article by Maybaum, Snyder and Coleman,⁴ although it appears in the 1939 literature, deserves mention now, because it points out that the masking effects of the drug are such that better and sharper clinical acumen will be needed to evaluate the bedside picture in its relation to the necessity of intervening surgically. I believe that newer basic concepts regarding the interpretation of roentgenograms made *after* sulfanilamide has been given for some time will have to become general. Furthermore, a different formula comprising indications for surgical intervention needs popularization—all to the end that the patient shall come to the otologist and be treated by him before both the gravity of prognosis and the difficulty of diagnosis are increased.

ACUTE LESIONS

In the review of the literature last year (1937) attention was drawn to the work of Luscher and Rotmann⁵ on otomicroscopy of the tympanic cavity. Miodonski⁶ confirms the observations of Luscher, particularly as concerns the distribution of the capillaries in the tympanic membrane. Under the high power magnification available to him, he was able to determine that the ravinian fissure is not an opening at all, as is commonly believed, but is an atrophic area in the region of the pars flaccida. This may seem unimportant, but it has implications relative to the genesis of primary cholesteatoma and the finding of small cholesteatomas in this region without tympanic suppuration.

Magnoni⁷ restudied the reparative processes of the membrana tympani, which had been worked out by Stinson⁸. He studied 10 cases. He was able to confirm the finding that the epidermis of the membrana tympani moves from the center of the drum toward its periphery near the external auditory canal. He did not find that this travel of the dermal layer of the drum goes on with the regularity of direction reported by Stinson, but in the main he confirms Stinson's observations. This substantiation is of value in estimating the prospects of healing and repair of a perforation in the membrana tympani and when better understood may influence the point of election to paracentesize the drumhead for acute suppuration.

4 Maybaum, J. L., Snyder, E. R., and Coleman, L. J. The Value of Sulfanilamide in Otogenous Infections, with Special Reference to Its Masking Effect, *J. A. M. A.* **112** 2589 (June 24) 1939.

5 Lüscher, E., and Rotmann, S. S. Typische otomikroskopische Befunde der Mittelohrtuberculose, *Ztschr. f. Hals-, Nasen- u. Ohrenh.* **39** 10, 1935.

6 Miodonski, J. Beitrag zur Mikroskopie des Trommelfelles, *Monatschr. f. Ohrenh.* **71** 742, 1937.

7 Magnoni, A. Osservazioni sulla migrazione dell'epitelio della membrana timpanica, *Valsalva* **14** 234, 1938.

8 Stinson, W. D. Reparative Processes in the Membrana Tympani, *Arch. Otolaryng.* **24** 600 (Nov.) 1936.

An interesting pathologic condition and one which is exceedingly rare is reported by Klister.⁹ On otoscopic examination, a small mass was found occupying the area of the posterior sector of the drumhead, mostly lying in the superior quadrant. Under magnification this was made out to be a neoplastic growth, either an exostosis or an osteoma arising from the hammer handle. The condition caused no symptoms. There was no report as to whether acuity of hearing was lost. I suspect that there might have been such a loss. Klister's is the tenth such case reported in the literature.

In European otologic and pediatric literature, the controversy concerning otitis in infants and its relations to disturbances of nutrition is still being carried on unabated and without much prospect of being settled by generally acceptable concepts. Ten Bokkel Huinink¹⁰ reports that of 1,130 infants observed by him, nutritional disturbances were present in 24 per cent, and diseases of the respiratory tract accounted for illness in 31 per cent. Of the latter group, 50 per cent had purulent otitis media, whereas in those with intestinal disorders only 20 per cent had otitis. The author advocates that antrotomy be performed in all cases in which pediatric therapy is not effective. He advocates surgical intervention in such cases even when it is impossible clinically to diagnose otitis media.

This report seems to epitomize the European opinion on the problem at present. In America there is a tendency to limit surgical intervention to cases in which pathologic changes are diagnosed or deduced from the otologic aspects. Tóbl,¹¹ in his study of 1,400 infections of the middle ear in infants and very young children, reports that only 97, or 7 per cent, required mastoidectomy. Of course, he bases his findings solely on the presence of demonstrable pathologic changes. I purposely avoid quoting and citing the many other reports in the literature of the year under scrutiny, because to do so would only be a reiteration of positions previously reported. Not since the publication of the work of Alden and Marriott and the fine Canadian study some years ago has anything of moment been added to the discussion of this topic. It seems desirable that some large pediatric clinic in this country should undertake another study of antrotomy for the relief of nutritional disturbances in infants, in an endeavor to determine the benefits obtainable.

9 Klister, M. A Case of Exostosis of the Hammer Handle, *Arch. sov. otol.* **1**:33, 1938.

10 ten Bokkel Huinink, A. Otitis in Infants and Nutritional Disturbances, *Maandschr. v. kindergeneesk.* **7**:91, 1937.

11 Tóbl, P. Mittelohrentzündungen im Säuglings- und Kleinkinderalter, *Zentralbl. f. Hals-, Nasen- u. Ohrenh.* **29**:32, 1937.

Last year I commented on tetanus as complicating otitic infection Stout¹² reports 2 additional cases, which came under his observation In both the condition was associated with acute purulent otitis media, the otitis preceding the appearance of the tetanus Stout believes that these are probably cases of tetanus of the atrium

Nunzi¹³ observed 12 cases of diphtheria of the external and middle ear and the mastoid process Reviewing the literature, he finds that characteristic symptoms of this specific infection, beyond the presence of the Klebs-Löffler bacillus, are not recorded From an analysis of his own cases, he finds that diphtheritic otitis media purulenta makes its clinical appearance suddenly without any notable subjective symptoms Paracentesis yields a serosanguineous fluid followed within a few days by a dirty gray secretion The otoscopic picture is that of purulent otitis media Removing the secretions, one observes shreds of detritus and pseudomembrane in the external auditory canal When the patients come to operation on the mastoid process, extensive destruction of the mastoid cellular elements is found The appearance of the field of operation resembles that in mastoiditis associated with scarlet fever In addition to surgical intervention, therapy consists in intravenous and intramuscular administration of antitoxin and local tamponade of the wound with the same serum

In dealing with the contagious diseases and the otitides which ensue, it is germane to note the comprehensive reports made by Horace Williams,¹⁴ whose material has particular reference to otitides accompanying scarlet fever The cases studied were collected between 1934 and 1937 from the Philadelphia Hospital for Contagious Diseases Williams is of the opinion that scarlet fever produces more acute otitis media than does any other specific disease The second source of origin is given by him as measles In the period under survey, of 15,140 patients with scarlet fever, acute otitis media purulenta developed in 8.6 per cent One third had bilateral involvement Eight and three tenths per cent of the ears, belonging to 115 patients, required simple mastoidectomy, which was performed The mortality among 115 patients was 10, or 8.7 per cent Williams classifies the material into three groups Group 1 comprised 1,049 ears on which myringotomy was performed before the membrana tympani ruptured In group 2 there were 190 ears in which the membrana tympani ruptured spontaneously but nevertheless additional paracenteses were required In

12 Stout, P. S. Tetanus Associated with Acute Otitis Media. Probable Atrium Tetanus, Report of Two Cases, *Laryngoscope* **48** 682, 1938

13 Nunzi, A. Sulla differite dell'orechios, *Ann di laring, otol* **37** 172, 1937

14 Williams, H. J. Otitis Media and Orbital Cellulitis Complicating Scarlet Fever. Preliminary Report on Loss of Hearing from This Disease, *Tr Am Laryng, Rhin & Otol Soc* **44** 134, 1938, *Arch Otolaryng* **29** 82 (Jan) 1939

group 3 Williams places 553 ears in which the membrana tympani ruptured spontaneously and further paracenteses were never required. In group 1, two incisions of the drum head were needed and done in 144 ears, three, in 32 ears, four in 13 ears, and five, in 3 ears. In group 2, there were 19 ears in which two incisions of the drum head were done, while 6 ears required three incisions. The incidence of mastoiditis requiring surgical intervention was 5.5 per cent in group 1, 13.2 per cent in group 2 and 5.8 per cent in group 3.

Williams states as his observation that early paracentesis did not lower the incidence of mastoiditis requiring surgical intervention. He nevertheless advocates it to relieve pain and reduce temperature and as the best means of avoiding mastoidectomy. I may remark here, in passing, that this opinion stands somewhat in contradiction to his conclusion based on his observed cases. Every otologic surgeon, when doing an early paracentesis, *hopes* by this means to avoid the development of mastoiditis requiring surgical intervention. But neither the numerous recorded experiences nor Williams' own observations present any substantial scientific data to support this hope. Too many factors other than the drainage of the tympanic cavity play a role in the development of mastoiditis requiring surgical intervention, factors which paracentesis, per se, cannot influence. Williams deduces, further, that repeated paracenteses have small value, provided the original incision into the tympanic membrane was adequate and that free drainage is established. With this point of view I am in full accord, and in these reviews I have repeatedly brought observations from the literature to substantiate it. Of 1,300 patients in Williams' study, 15.7 per cent had had the adenoids and tonsils removed. It is somewhat to be regretted that comparative studies of the tonsillectomized and the nontonsillectomized patients were not made in an endeavor to add data on the influence on otitis of the operations for the removal of tonsils and adenoids.

Finally, Williams reports on the work of Whoopie and Cave, who examined the sinuses roentgenologically in 292 cases of scarlet fever. In 91 per cent pathologic shadows appeared. No ear evidenced purulent otitis media unless purulent sinusitis also was present. This observation may perhaps hold a key to preventive measures among patients with scarlet fever. The early search for infections of the paranasal sinuses might become a routine institutional procedure in hospitals for contagious diseases. If the findings of Whoopie and Cave are substantiated, it seems that discovery and prompt elimination of lesions might be a means of lessening the incidence of otitis media purulenta among patients with scarlet fever. One other potent observation is cited from Whoopie and Cave, namely, that the incidence of involvement of the paranasal sinuses

was not less in the tonsillectomized group than among those who had not had the tonsils and adenoids removed, in fact, it was proportionately greater.

One cannot leave so fine a study, embracing, as it evidently does, much painstaking observation and exact findings from repeated otologic examinations without expressing a slight disappointment that this large amount of material was not additionally submitted to observations which might throw light on fundamental questions which are still mooted. For example, what type of bony structure predominated among the patients who came to operation? In what proportion did chronic conditions develop and on what bony structure did these conditions seat themselves? What was the duration of the otitis relative to its early or late appearance in the course of scarlet fever? I record some of these questions here in the modest hope that Williams will continue this type of study and perhaps be induced to add them to his analyses in future reports.

Another report on the aural complications of scarlet fever comes from the Municipal Contagious Disease Hospital of Chicago. Hoyne and Spaeth¹⁵ report on 3,564 cases of scarlet fever which were observed in one year—from July 1, 1934 to June 30, 1935. Of these, otitis media purulenta developed in 476, or 13.35 per cent, and of this number 124 required mastoidectomy. From Rumania Gheorghe¹⁶ reports that during the epidemic of scarlet fever which occurred in 1936-1937 he observed 980 cases of scarlet fever in 116 of which acute otitis media purulenta occurred. Mastoiditis requiring surgical intervention developed in only 7 of these.

These reports assume larger import and significance because of the general popularity of sulfanilamide, the advocates of which contend that its use markedly lessens the incidence of otitic complications both from infections of the upper part of the respiratory tract and from those complicating the exanthemas. Likewise, it is generally alleged that the administration of sulfanilamide in cases of acute purulent otitis media has materially reduced the incidence of mastoiditis requiring surgical intervention. Study of the authoritative reports herein cited, with the small percentage of cases in which mastoidal complications requiring surgical intervention appeared before the advent of sulfanilamide, brings these contentions into serious question, and I am at a loss to find substantiation of Watson-Williams'¹⁷ positive statement that sulfanilamide

15 Hoyne, A. L., and Spaeth, R. The Ear Complications of Scarlet Fever, *J. Pediat.* **12** 287, 1938.

16 Gheorghe, I. Mastoiditis in the Course of Scarlet Fever, *Rev. romana de otolaryng.* **4** 21, 1937.

17 Watson-Williams, E. Sulfanilamide in Treatment, *Bristol Med.-Chir. J.* **54** 209, 1937.

is of definite value in the control of infections of the middle ear. He makes no case reports or other comparative studies to show on what he bases his contention.

Carey¹⁸ treated acute purulent otitis media with adequate doses of sulfanilamide in 8 cases, yet surgical intervention was eventually required in 2. On the other hand, Livingston¹⁹ states that 5 patients whose condition had been diagnosed as mastoiditis requiring surgical intervention and who according to the usual standards would have been submitted to operation recovered without operation with administration of sulfanilamide. Livingston, however, is more judicial in his attitude. He observes that it is well known that in some years the organisms infecting the respiratory tract in epidemics are much more virulent than in other years. With this view I am in accord. There is a distinct variation in the type, nature, severity and tendency to complications in different years and occasionally in different months of a given year. It may not be amiss to recall an earlier publication of Kopetzky and Hadjopoulos,²⁰ in which this variation was studied over six years. The report, concerned mostly with streptococcic infections, showed that they reveal orderly periodicity, with a suggestion that a major cycle embraces five to six years. In studying the effects of sulfanilamide as a hindrance to complications of purulent otitis media, this periodicity in the incidence of grave conditions must be given due consideration. My personal experience during 1937, before sulfanilamide was given in almost every case, shows that the number of patients coming into the hospital with the mastoid in a condition to require surgical intervention had fallen considerably. During the winter of 1938 and 1939, even though sulfanilamide was used much more frequently, the number of patients requiring mastoidectomy has increased.

Nevertheless, I quote from the study of Schenck,²¹ who gives a comprehensive analysis of the use of sulfanilamide to date:

In regard to otitis media the situation is too complex for satisfactory evaluation of the drug. There is as yet no evidence that the drug prevents extension of the infection from the middle ear to the mastoid cells, although pediatricians in general feel that fewer mastoid infections followed infections of the middle ear when treatment with sulfanilamide was employed during the winter of 1937-1938.

18 Carey, B. W., Jr. The Use of Para-Aminobenzenesulfonamide and Its Derivatives in the Treatment of Infections Due to the B-Streptococcus Hemolyticus, the Meningococcus, and the Gonococcus. Report of Thirty-Eight Cases, *J. Pediat.* **11** 202, 1937.

19 Livingston, G. S. Sulfanilamide Therapy, *Arch. Otolaryng.* **27** 242 (Feb.) 1938.

20 Kopetzky, S. J., and Hadjopoulos, L. G. The Relationship of Upper Respiratory and Alimentary Tract Flora to Mastoid Infections, with Special Reference to the Epidemiology of Mastoiditis, *Laryngoscope* **42** 661, 1932.

21 Schenck, H. P. Use of Sulfanilamide in Otolaryngology. Review of the Literature, *Arch. Otolaryng.* **28** 698 (Nov.) 1938.

It has long been a common observation among otologists that grippal infections present a characteristic otoscopic picture and often a specific pathologic development not comparable to ordinary otitic infections. The otoscopic picture often shows blebs scattered over the surface, or dermal side, of the membrana tympani. Tobeck²² in his study of gripp-otitis states that the hemorrhagic blebs both in the canal and on the drum head are the result of toxic trauma to the capillaries. He holds that this condition precedes the onset of actual bacterial invasion of the spaces of the middle ear. He groups his findings under three headings: first, otitis externa grippalis, second, otitis media acuta grippalis, and third, labyrinthitis serosa or purulenta grippalis. In this connection, the report of Ruskin²³ is important and interesting. On the basis of a study by Hess,²⁴ who was concerned with the frequency of grippal infections in persons with scurvy, Ruskin treated myringitis haemorrhagica bullosa grippalis with massive doses of a vitamin C product, using calcium cevitamate (ascorbate). He employed a 15 per cent solution of this drug, administering 3 cc of it daily and sometimes more often. He proceeds on the theory that those subject to otitic grippal infections are in a stage of preclinical scurvy. His results are interesting. The pain in the ear disappears in all instances within twenty-four hours, and he reports his patients cured within four days. In view of my contention that the membrana tympani showing distinct blebs should not be incised and in view of Tobeck's study, this therapy may hold the answer in the given situation, for the most distressing symptom, otalgia, is relieved promptly. Whether Baer²⁵ had the same idea, I am unable to determine, because he says nothing of the preclinical stage of scurvy in grippal otitis. Nevertheless, he too reports good results after having used vitamin C in 15 cases of otitis media purulenta acuta.

For years the literature has reiterated reports of the specific clinical pictures in cases of infection with *Streptococcus mucosus capsulatus*; the meager signs of involvement of the middle ear, the insignificant mastoidal reactions and then the sudden flare-up, with the advent of grave intracranial complications. Later, the organism was identified as *Pneumococcus* type III, with a differing growth on culture mediums, showing on one hand a growth characteristic of the streptococci and on the other hand having pneumococcic features. This varying trend was evident also in the reactions of human tissue when the organism

22 Tobeck, A. Die Grippeerkrankungen des Ohres, *Med Klin* **34** 349, 1938.

23 Ruskin, S. L. Contribution to the Study of Grippe Otitis, Myringitis Bullosa Hemorrhagica, and Its Relationship to Latent Scurvy, *Laryngoscope* **48** 327, 1938.

24 Hess, A. F. Infantile Scurvy. Study of Pathogenesis, *Am J Dis Child* **14** 337 (Nov.) 1917.

25 Baer, M. Otite moyenne et vitamine C. *Rev de laryng* **59** 165, 1938.

invaded the middle ear. According to Profant,²⁶ infection with Friedlander's bacillus in the mastoid process is similar in its effects to that with *St. mucosus capsulatus*. Its most significant feature consists in the production of a sticky mucoid colony on culture mediums and likewise of a sticky mucoid reaction in the tissue involved. Profant cites an interesting case. He makes an important point in the "timing" of his surgical intervention at the end of the first week after myringotomy and three weeks after the onset of the meager symptoms of involvement of the middle ear. His judgment was substantiated by his operative findings, for, although the cortex and its underlying cell structures seemed firm and not markedly involved, nevertheless the deeper into the mastoid process he proceeded after he had removed them, the more evident the pathologic changes became. He was amazed to find the plate of the lateral sinus and the dural plate over the atrium and the mastoid entirely destroyed.

CHRONIC LESIONS OF THE MIDDLE EAR

In the older literature the danger of removing polyps from the middle ear was often stressed. Repeated warnings were given of the possibility of dural attachments of some polyps. From the trauma to the dura inherent in their removal, in the face of infection of the middle ear meningitis often subsequently developed. From observation of current practice some clinics where aural polyps are removed by snare with the patient under local anesthesia and the whole procedure considered "minor," I am impelled to record the presentation of Dannheimer,²⁷ who again recalls the dangers of depending entirely on otoscopic examination to diagnose the neoplasm, which is seen as "aural polyp," and proceeding forthwith to remove it. In a 53 year old patient, whose symptoms were gradual onset of paralysis of the facial nerve, vertigo, headache, vomiting and eventually hoarseness, ptosis and palsy of the abducens nerve, the affected ear showed only a polypoid growth in the middle ear. Necropsy indicated that the growth was a meningioma originating in the middle cranial fossa, which had extensively eroded the temporal bone. Thus not only the dangers to the dura from trauma but the very character of the so-called polyp is in question until its removal and examination. According to the old teaching of Dench and others, the spaces of the middle ear should be opened and the surgical removal undertaken with the same care and precautions as would be used for the removal of a neoplastic growth anywhere else in the body.

26 Profant, H. J. Mastoiditis Caused by Friedlander's Bacillus, *Tr. Am. Laryng., Rhin. & Otol. Soc.* **44** 498, 1938.

27 Dannheimer, W. Zur Kasuistik der Ohripolypen, Hals-, Nasen- u. Ohrenheilk. **28** 343, 1937.

There is always interest in reports on cholesteatoma. This by-product of nature's effort to procure healing in chronic conditions has engaged the study of otologists for decades. The sequence of growth, the manner in which its mass takes shape, like an expanding neoplasm, its absorption of the bone on which it lodges by exerting mechanical pressure on it and the extent to which it may invade vital structures give each report an interesting aspect. Holmes²⁸ has performed a service in his review of 303 cases of cholesteatoma. He believes that "primary" cholesteatoma, with an intact drum head, is more frequent than most otologists think. By "primary" cholesteatoma is not meant "true" cholesteatoma. There are several reports of this lesion in this year's literature. The one by Friedman and Quittner²⁹ describes a patient whose illness commenced with paralysis of the facial nerve, spasmodic twitchings, impaired hearing and narrowing of the external auditory canal, without otorrhea or evidence of aural infection. The membrana tympani appeared normal. Roentgen examination revealed sclerosis of the right mastoid process and the suggestion of a cholesteatoma. At operation this lesion was found. The facial nerve, exposed to its encroachment to the extent of 15 mm, was dark brown. The patient recovered. Diamant³⁰ watched the development of a cholesteatoma behind an intact and microscopically unchanged membrana tympani. He concludes his study with the statement that perforations of the drum head in the region of the attic and the antrum are not necessarily the result of otitic suppuration but are due to the pressure on Shrapnell's membrane—positive on the side toward the canal and negative on the epitympanic side—causing an indrawing of this portion of the membrana tympani. Thus he substantiates observations of Wittmaack, who called the lesion primary pseudocholesteatoma. It must not be confused with true cholesteatoma, which is congenital. The pressure to which Diamant calls attention results from the production of hyperplasia of the mucosa which, by virtue of adhesions, completely shuts off this portion of the epitympanic space from the remainder of the middle ear. The air which remains in the enclosed space is absorbed by the blood in the capillaries, hence, the negative pressure. Such a condition may be present for years without interfering with the auditory function or causing the patient any annoyance. However, when a secondary infection sets in, true "choles-

28 Holmes, E. M. A Review of Three Hundred and Three Cases of Cholesteatoma, *Ann Otol, Rhin & Laryng* **47** 135, 1938.

29 Friedman, M. D., and Quittner, S. S. Cholesteatoma Verum of the Right Mastoid, *Arch Otolaryng* **28** 209 (Aug.) 1938.

30 Diamant, M. Acute or Chronic Otitis Media, *Acta oto-laryng* **25** 507, 1937.

teatomeiterung" becomes evident. Both Laskiewicz³¹ and Bernheimer³² cite what they believe to be cases of primary cholesteatoma of the mastoid process. Reading their reports I question this contention. In Laskiewicz's case a 12 year old child suffered from otitis media purulenta which followed an attack of scarlet fever. Simple mastoidectomy was done. The wound healed, and after a time fever and all the symptoms of reinfection of the mastoid process appeared. At the second operation, a large cholesteatoma was found to occupy the cavity left by the first operation.

I cannot comprehend on what grounds Laskiewicz terms this congenital cholesteatoma, with his own record of purulency of the middle ear which followed scarlet fever. Acute necrotic otitis media is not uncommon, particularly after scarlet fever. Sometimes symptoms supervene in the course of this lesion which necessitate simple mastoidectomy. Subsequently the middle ear continues to discharge because the osseous reabsorption has not been reached by the technic of the simple mastoidectomy and remains in the hypotympanic and epitympanic spaces. Wittmaack and Almour³³ have also shown that the reparative processes in such cases consist of an ingrowth of epithelium from the external auditory canal in an endeavor to cure the chronic condition. In its ingrowth, the epithelium finds a large cavity artificially created by the surgical intervention on the mastoid process, which it readily lines. In encountering irregularities of surface and small bony obstructions, it is thrown on itself, and this, added to its characteristic desquamation, forms a pseudocholesteatoma in the cavity. In Bernheimer's case also there is doubt as to the cholesteatoma being a real primary one since surgical intervention preceded the development of the lesion. A patient, many years before coming under the author's observation, had a post-auricular incision to remove a foreign body from the external auditory canal. When first seen by Bernheimer he had a granulating fistula on the posterior wall of the canal from which pus discharged. The membrana tympani and the middle ear appeared normal on otoscopic examination. At operation a large cholesteatoma of the mastoid process was found.

The surgical treatment and general management of chronic mastoiditis is on a rather set basis. Hastings³⁴ brings up a point on which comment may be allowed. Concerning the operative treatment of chronic mastoiditis, he recommends that in cases of central perforation

31 Laskiewicz, A. Du cholestéatoma congenital. *Rev. de laryng.* **58** 281, 1937.

32 Bernheimer, L. B. Primary Cholesteatoma of the Mastoid, *Arch. Otolaryng.* **27** 135 (Jan.) 1938.

33 Almour, R. Significance of Squamous Epithelium in the Cause and Repair of Chronic Middle Ear Disease, *Tr. Am. Acad. Ophth.* **35** 357, 1930.

34 Hastings, S. The Operative Treatment of Chronic Mastoid Disease, *J. Laryng. & Otol.* **53** 246, 1938.

in which the hearing is good and the chronic disease of short duration antrotomy (simple mastoidectomy) be performed. This is his operation of choice. When the lesion is of longer duration, a conservative radical operation is recommended. With marginal perforation and good hearing, Hastings prefers a modified radical, and in all other cases a radical mastoidectomy. The use of the term "chronic mastoid disease" by Hastings is unhappy. It is not a pathologic diagnosis, and hence it is difficult to comprehend for what kind of lesion he is recommending a given procedure. Chronic otorrhea is a symptom common to many otitic lesions. Centrally located perforations are generally characteristic of suppurative lesions confined to the mucosa, are nondangerous and rarely require surgical intervention. The description of the types of lesion for which Hastings recommends his various operative techniques would clarify the issue. A chronic aural discharge is too often the result of a specific lesion in the middle ear to have either diagnosis or surgical therapy based on the time that it has been present.

INFECTIONS OF THE BLOOD STREAM

I am indebted to the report made by Cody² before the Southern Section of the American Laryngological, Rhinological and Otological Society for drawing attention to the fiftieth anniversary of the first successful operation for thrombosis of the lateral sinus, by W. Arbuthnot Lane.³⁵ Lane's original report, as Cody points out, already presented the question whether one should ligate the internal jugular vein to get the best results. The question is still pending. Cody reviews the symptoms and the operative findings, discusses the Tobey-Ayer phenomenon as a diagnostic aid, draws attention to anatomic variations of the cranial sinuses and points out their clinical aspects. He lists four purposes accomplished by ligation of the jugular vein:

First, as a preventive measure to impede the entrance of emboli into the lung as infarcts from the proximal end of the thrombus. Second, as a protection against the possibility of a mural thrombus in the jugular bulb becoming an embolus. Third, to demark positively the limit of the proximal extension of the thrombus in the internal jugular vein and if the jugular be thrombosed to resect it. Fourth, as a secondary defense against bacteraemia. The ligation of the jugular seems to be effective in those cases of thrombosis operated upon reasonably early, but in the advanced cases, chills occur frequently after ligation where the invading bacteria are quite virulent, ligation has little effect on the sepsis.

Cody's personal observations comprise 16 consecutive cases in which thrombosis of the lateral sinus occurred, among 518 mastoidectomies, or 3 per cent of his cases of mastoiditis requiring surgical intervention, with a mortality of 25 per cent. He finishes his report with a note on the

³⁵ Lane, W. A. Five Cases of Complicated Diseases of the Middle Ear, *Tr. Clin. Soc. London* 22: 255, 1889.

effect of sulfanilamide, to which I have alluded in the introductory paragraph of this article. Evans³⁶ in his survey of current opinions and records tabulates the result of a questionnaire regarding the incidence of the lesion. Only nineteen of the three hundred and forty-three replies received from otologists and institutions reported an incidence higher than 6 per cent. Evans comments on the finding that among those who reported to him higher incidences of occurrence were some of the outstanding specialists of the country. He observes that the figures from these surgeons do not give a true picture of the percentage of occurrence of sinus thrombosis but rather are the result of the larger number of referred patients coming to them for specific operative therapy, the thrombosis not actually occurring, in every case, in their individual practice. In making studies of the incidence of sinus thrombosis in the run of cases of mastoiditis requiring surgical intervention, thrombosis occurring in extramural practice should be separately considered. The surgeon should have reported only the cases in his own practice in which thrombosis developed from mastoiditis under his observation. The records which Evans reviews deal with 59,850 cases of mastoidal infection. Among these, 1,556 cases of sinus thrombosis are noted. These figures yield an incidence of 2.6 per cent of thrombosis of the lateral sinus in mastoidal disease. Behrman³⁷ studied cases covering twenty-six years, between 1910 and 1936. There was a mortality of 32 per cent. In 65 per cent of the cases sinus thrombosis developed after acute purulent otitis media. The record is of 104 cases.

Sutherland³⁸ discussing otitic sinus thrombosis notes that the medical profession has not as yet become fully aware that otitic sepsis can have its focus in some other part of the vast venous network surrounding and penetrating the various portions of the temporal bone. This view is substantiated by Lillie,³⁹ who states in the introductory remarks of his monograph on surgery for sepsis of otitic origin "that in the extensive literature the tendency has been to consider infections of the blood stream that are associated with infections of the temporal bone under the general term 'sinus thrombosis'." I have for years taught and written in the same vein and am in full accord with both Lillie and Sutherland. The latter's comment that it is much more important to remove the primary focus in the bone itself for the cure of otitic sepsis

36, Evans, W. H. Thrombosis of the Lateral Sinus. A Survey of Current Opinion and Records, *Arch. Otolaryng.* **28** 959 (Dec.) 1938.

37 Behrman, W. The Sinus Thrombosis Material of the Sahlgren Hospital, 1910-1936, *Acta oto-laryng.* **25** 534, 1937.

38 Sutherland, J. M. Otitic Sinus Thrombosis, *Arch. Otolaryng.* **27** 1 (Jan.) 1938.

39 Lillie, H. I. Surgery of the Ear, New York, Thomas Nelson & Sons, 1938 chap. 9, p. 262.

than operatively to attack a definite portion of the venous system, because of the wide anastomosis of the veins around the temporal bone, also deserves attention. The plea for early surgical intervention made by Beck in reporting his cases of so-called "thrombotic mastoiditis" and in connection with the group of cases of sepsis which I have classified as instances of "hemorrhagic mastoiditis" falls into the same category. Sutherland particularly stresses the importance of the anomalies in the anatomy of the lateral sinus and of the sagittal and the petrosal veins and the petrosquamous sinus in infancy. He stands on firm ground in his recommendations as to therapy, namely, eradication and drainage of the primarily infected area.

As an aid to diagnosis the Tobey-Ayer tests have in the main proved their worth, a few errors and failures to the contrary notwithstanding. Van Dishoeck⁴⁰ presents a test based on similar principles. When pressure is exerted on the internal jugular vein of one side, the turbinate tissue in the nose swells on the same side. This results from retrograde congestion of the pterygoid plexus with blood from the cranium. The test is performed as follows. An inflated finger cot is placed over a rubber cork through which a glass tube is passed. The protruding end of the glass tube is connected with a water manometer. The finger cot is inserted into the nostril and placed in apposition with the inferior turbinate body of the nose. The pressure is recorded. Manual pressure is then exerted over the internal jugular vein and the pressure again noted. When the condition in the lateral sinus is normal, a rise in pressure in the manometer is to be noted from impingement of the engorged turbinate against the finger cot. When a sinus thrombosis is present, there should be no perceptible increase in the pressure recorded by the nasoplethysmometer. The value of this test is still to be determined.

Juers,⁴¹ evaluating symptoms in a study of 21 cases of otitic sepsis, with a mortality of 24 per cent, finds that he can show no relation between chills and bacteremia. He reports a positive blood culture in only 11 of his cases. His observation is that chills were more frequent among children than is generally supposed. He placed considerable stress on headache as a significant diagnostic sign. The failure to procure a positive blood culture in half of his cases deserves attention. The finding of a positive blood culture is proof of bacteremia. The negative finding, however, is not open to such a clearcut deduction. If the surgeon is absolutely sure that there has been no technical failure in

40 van Dishoeck, H. A. E. Nasenplethysmometrie als Mittel zur Diagnose der Durchlässigkeit des Sinus sigmoideus und der Vena jugularis, *Acta oto-laryng* 26 45, 1938.

41 Juers, A. L. Otitic Sepsis. Analysis of Twenty-One Cases and Anatomic Study, *Arch Otolaryng* 27 178 (Feb.) 1938.

taking the blood for the culture, if no error has occurred in the preparation of the medium, its reactions or the temperature at which it is kept, if the bacteria drawn from the patient with the blood are of a type that will grow colonies on the medium and—finally—if the concomitant signs and symptoms warrant the assumption that bacteria are present, then the failure to get positive blood cultures in half of a series of cases is noteworthy. Otherwise, a negative finding from blood culture becomes only a matter to record, and one may yet deduce that bacteremia is present. On the question of a positive or a negative finding from blood culture a large amount of literature exists, and no purpose would be accomplished at this time by reopening it.

Years ago I was taught by Jonathan Wright, and I still believe it true today, that when chills and a septic temperature curve are presented bacteria are generally found in the blood stream, whether or not they can be demonstrated on artificial culture mediums. This is considered true particularly when other signs of bacterial infection occur, such as a progressive fall in the hemoglobin index and a progressive loss in the total red blood cell count. Such a deduction is especially likely to be correct when the pathogenic organism is of the hemophilic type. Scalori⁴² reports a case of a child 9 years of age on whom simple mastoidectomy had been performed on the left. Forty days post-operatively follicular tonsillitis developed, accompanied by purulent otitis on the right. On the second day of this illness, paracentesis was done, yielding only a scant discharge of pus. Severe sepsis immediately set in, bringing death on the fourth day of illness. Autopsy showed the presence of thrombophlebitis of the right sigmoid sinus. Scalori believes that in this instance the route of infection was retrograde thrombosis. The autopsy report does not trace the regression from the middle ear to the lateral sinus, but in view of the studies of Hadjopoulos and Bell,⁴³ who traced infective bacteria through the lymphatics as well as through the blood stream, it seems that Scalori's opinion is substantiated. When discussing Hastings' paper and commenting on his report on chronic lesions of the nondangerous type which presented central perforations, I did not touch on superimposed infections in such cases, which are dangerous and change the character of the conditions. Thus Klicpera⁴⁴ reports on 7 cases in which sinus thrombosis occurred in the presence of chronic purulent otitis media with central perforations. In 6 of these, the acute flare-up followed bathing. In only 3 cases did the otoscopic

42 Scalori, G. Tromboflebite otogena precocissima del seno laterale, *Valsalva* **13** 585, 1937.

43 Hadjopoulos, L. G., and Bell, J. W. Direct Versus Intermediate Pathways in Infections of the Mastoid, *Arch Otolaryng* **25** 601 (June) 1937.

44 Klicpera, L. Sinusthrombosen bei chronischer Mittelohreiterung mit zentraler Perforation, *Monatschr f Ohrenh* **71** 1321, 1937.

picture give any evidence of the acute exacerbation, and in 1 the middle ear actually was dry. The bony structure in all these cases showed disturbance of pneumatization, and in all of them the infection followed the tissues by contiguity of structures, bridging the space between the antrum and the lateral sinus and passing through the chain of cellular structures and the lymph channels. Radical mastoidectomy was done in 2 instances and simple mastoidectomy in 5, besides surgical treatment of the lesion in the lateral sinus. Six of the patients recovered.

Behrman⁴⁵ finds no difference in the results of treatment with and without ligation of the jugular vein, while Atkinson⁴⁶ discusses treatment of infection of the lateral sinus without operation on the vein. He limits ligation or resection to cases of tenderness along the course of the jugular vein, enlarged glands in that region or repeated rigors after operation on the sinus. In 5 cases of sinus thrombosis he ligated the vein in 2, because the bulb of the vein itself was involved. In this, as in many publications, the stress in discussion of therapy is placed on ligation or nonligation of the internal jugular vein. Gill,⁴⁶ on the contrary, contends that the treatment of infections of the blood stream secondary to purulent diseases of the middle ear and the mastoid process is primarily medical and should consist of transfusions of immunized blood, administration of polyvalent antistreptococcus serum, intravenous injections of dextrose and sodium chloride and, lately, the administration of sulfanilamide.

LESIONS OF THE PETROUS PYRAMID

Many cases of suppuration of the petrous pyramid have been reported, mostly because of the increasing frequency with which the lesion is recognized clinically and operated on and the recovery or the death recorded. If the reports demonstrate nothing else, they are evidence of an increasing diagnostic acumen on the part of the general run of otologists. Among the leaders in this field of study, two strong trends are observable. In the first place, a diagnosis of petrosal suppuration per se is recognized as incomplete. The endeavor is to make a "diagnosis of localization," with the obvious corollary that surgical measures shall be devised to reach the locality diagnostically recognized as the seat of the lesion. The use of "standard procedures" for "petrositis" was evidently a passing phase in the development of both the diagnosis and the surgical treatment of petrosal suppurations. In the second place, the leading students of this condition are stressing the adoption of the

45 Atkinson, E. M. Treatment of Lateral Sinus Infection Without Operation on the Jugular Vein, *Arch. Otolaryng.* **27** 169 (Feb.) 1938.

46 Gill, E. G. Infection of the Blood Stream. Medical Treatment, with Special Reference to Transfusions of Immunized Blood, Report of Cases, *Arch. Otolaryng.* **27** 67 (Jan.) 1938.

"minimal" operation to accomplish results. Failure to effect cure with the "minimal" operation is followed by secondary operations more and more extensive, until cure results and a return to normal conditions is brought about. As a corollary of this second trend outstanding students of petrosal suppuration, like Ramadier and Almour, to give but two examples, who are authors of specific technics for surgical intervention on the petrous pyramid, are advocating their own surgical procedures for use not in all cases but only after a diagnosis of localization has established that other and minimal procedures would fail to eradicate the lesion. In the specific reports that follow I shall substantiate these observations with citations. Finally, I believe the time has passed when reports can be accepted of cases in which operation has been done without serious effort to classify the symptoms arising from the petrosal lesion, from the accompanying extradural abscess and from the meningitis which is present at the time of operation.

During the year under review interesting cases were reported by Frotzel,⁴⁷ Luquin,⁴⁸ Guillon and Hery⁴⁹ and Akai.⁵⁰ The condition in each case was diagnosed as "petrositis" and adequately handled. In Bologna, Italy, a symposium on petrosal suppuration was held at the congress of otolaryngologists.⁵¹ Bombelli⁵¹ reported finding a fistula in the hypotympanum, which he widened by curetting it. A lateral pharyngeal abscess developed, which was opened through the pharynx, with counterdrainage behind the sternocleidomastoid muscle. Monte⁵¹ reported a case in which diagnosis was not made during the patient's life but at autopsy bilateral osteomyelitis of the petrosa was discovered. I have referred in earlier summaries to reports similar to many in the French literature on osteomyelitis of the petrous pyramid among children and infants. Fioretti⁵¹ reported 2 cases in which diagnosis was made and healing occurred spontaneously after radical mastoidectomy. The American literature has many statements of the frequency of spontaneous cure of petrosal infection but extensive case reports with detailed descriptions of the symptoms and their "sequence of abatement" as recovery takes place are mostly lacking. Calicetti⁵¹ reported on 5 cases, with recovery in 2 and death in 3, while Giuffrida⁵¹ reported spontaneous recovery in 1 case and death in 1. In the latter the lesion

47 Frotzel, J. Acute Otitis Media with Suppuration of the Cells in the Petrous Apex, *Časop lek česk* **76** 1493, 1937

48 Luquin, P. T. Deep Seated Lesions of the Petrous Apex. *An Soc mex de ofal y oto-rino-laryng* **11** 317, 1937

49 Guillon, H., and Hery. Empvème clos de la pointe petreuse. Operation de J. Ramadier, *Guerison, Zentralbl f Hals-, Nasen- u Ohrenh* **30** 427, 1938

50 Akai, M. Two Cases of Petrositis. *Otologia* **10** 505, 1937

51 Proceedings of the Congresso della Societa italiana di laringologia otologia e rinologia, *Zentralbl f Hals-, Nasen- u Ohrenh* **29** 298 1937-1938

in the middle ear healed after eight days. Apicitis and fatally terminating leptomeningitis developed three months later. Although the observer does not say so, the course seems to be the classic one of pneumococcic meningitis.

Statements by Calamida,⁵¹ Giusani⁵² and Ricci⁵³ about operative treatment also were reported. Calamida prefers the Ramadier operative procedure to all others, but Giusani and Ricci both take the modern standpoint and recommend successive stages of operation, namely, the "minimal" procedure followed by more extensive procedures until the lesion is eradicated. The most impressive statement along these lines comes from Ramadier,⁵⁴ one of the French pioneer workers in this field. He reports that the operative procedure should fit the site of the lesion in the petrosa and that stress should be laid on the diagnosis of the site of the lesion by the recognition of the area from which the pus arises, that is, the middle ear or the mastoid process. For posterior lesions which surround the labyrinth, atticotomy (simple mastoidectomy) is indicated. For anterior lesions, he recommends either his own operation or that of Almour, provided that the labyrinth is alive. When a fistula is found, it should always be widened. He never uses a modified Streit operation, because he knows the danger of injuring the dura by such procedures. The extradural approach Ramadier reserves for cases in which evacuation of an extradural abscess is required. Finally, he finds that in certain cases apicectomy is needed. This is exactly the way I advocated handling petrosal suppuration in a brief case report.⁵⁵ In the second case reported in the same communication simple mastoidectomy was followed by watchful waiting, then radical mastoidectomy was performed, with drainage of an anterior fistula at the tubotympanic orifice, finally, after another interval of watchful waiting, apicectomy was performed to eradicate the lesion which was involving the meninges. My patient recovered. Two reports from Lund are available. In one⁵⁶ he describes his experience with deep osteitic suppuration of the temporal bone in 54 cases. Thirty-eight were cases of acute or subacute petrositis, in 13 the condition was termed chronic, and in 3 cholesteatoma occurred. In all, 89 foci in the petrous pyramid were encountered. Fifteen were located anteriorly and 74 posteriorly. Lund's operative procedures parallel Ramadier's and my own. He prefers to reoperate when it becomes necessary, awaiting the outcome from each procedure before extending the operative field. He

52 Ramadier, J. A. Les indications operatoires dans les petrosities, *Otorhino-laryng internat* **21** 489, 1937.

53 Kopetzky, S. J. Management and Treatment of Otogenic Meningitis, *Ann Otol, Rhin & Laryng* **47** 117, 1938.

54 Lund, R. Deep Suppurative Osteitis of the Temporal Bone, *Hospitalstid* **80** 313, 1937.

contends, furthermore, that the extrapetrosal approach as an independent surgical intervention has been entirely supplemented by intervention from within the petrosa. Those who are familiar with many of my numerous contributions will comprehend that Lund's advocacy of surgical intervention within the limits of the pars petrosa, without opening the cranial cavity and exposing the dura except when extradural abscesses are sought, meets full support from me. Gusic⁵⁵ reports on 10 cases. In 1 the lesion healed spontaneously, myringotomy only having been performed. In 3 a cure was effected by simple mastoidectomy (antrotomy) only. In another radical mastoidectomy became necessary. In 5 the Frenccknei or Ramadier technic was employed. When trans-labyrinthine cells are present Gusic prefers to operate according to the method of Frenccknei, otherwise, he prefers Ramadier's method of approach. Ninger and Hybášek⁵⁶ report on 6 cases of petrositis, in 5 of which diagnosis was made by clinical and roentgenologic examinations and in 1 at operation. These authors, too, feel that one must not have any fixed idea when operating in a case of petrositis. They deprecate the employment of a "routine means of surgical approach." In 3 of their cases radical mastoidectomy, in 1 simple mastoidectomy and in 2 only modified radical operations were necessary. They express their belief that for anteriorly located lesions the "minimal" operation is radical, and for posteriorly situated lesions, simple, mastoidectomy. Of course, in connection with both these procedures, the necessary surgical intervention on the exposed petrosal area is performed. How much more logical and scientific are these procedures, based on location of the pathologic change, than was the vaunted "conservative" attitude versus the "radical" attitude, based on "wishful thinking," of recent years! Of Ninger's and Hybášek's cases, peripetrosal extension and extradural abscess followed the "minimal" procedure in 2, in which the patient died. In the other 4 cures resulted, all procedures being intrapetrosally performed. Kopetzky⁵⁷ summarizes his conception of the surgical treatment of the petrous pyramid by reporting on a series of cases. In 10 simple mastoidectomy and widening and drainage of posteriorly situated lesions effected a cure. In 25 radical mastoidectomy was required, with enlargement of fistulas in anteriorly situated lesions. In 8 the Almour technic was employed for apical enclosed empyema, in 3 apicectomy was required. The lesion was posterior petrositis in 10 and anterior petrositis in 21. The lesions showed differing numbers of

55 Gusic, B. Ueber Pyramidenspitzenentzündung mit und ohne Gradenigosen Symptomkomplex, *Zentralbl f Hals-, Nasen- u Ohrenh* **30** 155, 1938

56 Ninger, F, and Hybášek, J. Otogenic Petrositis, *Sborn lék* **39** 1, 1937

57 Kopetzky, S. J. Surgical Treatment of Various Types of Lesions in the Petrosal Pyramid, *Surg, Gynec & Obst* **66** 395, 1938

fistulas, in 4 cases there were multiple fistulas. The apex was involved in 7 cases. Eleven patients had meningitis, of these, 4 died, and 7 recovered. In this report Kopetzky also cautions that one must suit the operative procedure to the individual case, and he characterizes the approach to the pyramidal structures from the pharynx and neck through noninfected areas as a "cadaver operation." Mangebeira-Albernaz⁵⁸ is another who does a "minimal" operative procedure first and then if no adequate beneficial response is obtained extends his surgical attack. He reports a case of petrositis in a 50 year old patient in which he first did antiotomy (simple mastoidectomy) and then, when symptoms remained unrelieved, proceeded to perform a Ramadier operation. The patient recovered. Tanaka and Hayashi⁵⁹ report 3 interesting cases wherein they also performed the least surgical intervention they believed necessary to reach the lesion. In a patient 41 years of age mastoiditis was complicated by petrositis and an extradural abscess. Simple mastoidectomy and evacuation were attempted. Meningitis ensued, and death resulted. In the second case, a 54 year old patient first complained of deafness. Simple mastoidectomy was done, to be followed in eight days by the clinical picture of petrositis. At operation a group of cells was found on the inner side of the posterior semicircular canal. The tract was eradicated, and a cure resulted in five weeks. The third case was that of a 17 year old student. Following coryza bilateral acute purulent otitis media developed apparently healing within the next three months, during which time the surgeons performed repeated myringotomies. A month later symptoms reappeared referable to the right ear. The drum appeared pale and thickened, and the posterior superior wall of the canal drooped. Simple mastoidectomy was performed, and transient improvement was noted. Two months later symptoms of petrositis set in, fever developed, and further operation was undertaken. At the radical mastoidectomy a group of infected cells was found which ran behind and medially from the sub-cochlear area toward the tip.

For the past seven years Lindsay⁶⁰ has been conducting a routine study of the temporal bones of meningitic patients coming to autopsy. His report to the Chicago Laryngological and Otological Society on the histologic picture of one or both temporal bones in 28 cases of meningitis is a fine detailed study, which must be read in the original to be properly appreciated. It is extensively illustrated with photomicrographs, which clarify the text. In addition, he reports 11 cases in detail,

58 Mangebeira-Albernaz, P. Petrositis with Gradenigo's Syndrome, *An de oto-rino-laring d Uruguay* 7 47, 1937.

59 Tanaka, H., and Hayashi, T. Complications of Mucosusotitis. Petrositis, *Otologia* 2 4, 1938.

60 Lindsay, J. R. Suppuration in the Petrous Pyramid, *Ann Otol, Rhin & Laryng* 47 3, 1938.

from the clinical, the operative and—when death followed—the histologic point of view. Space prohibits me from reproducing the case histories, but a summation suffices. Eight patients died of meningitis. Three patients with petrositis recovered. In 5 of 7 cases, including those of patients clinically observed and cured, a fistula to the middle ear was not demonstrable. These cases illustrated that an abscess in the apex frequently cannot be reached from the mastoid process. Lindsay finds that the abscess in the apex is often closed and that rupture may take place in one of several directions. He states that in every case the infection reached the pyramid by way of the pneumatic spaces, producing an area of suppuration and abscess in the bone. Later there was rupture into the meninges. The bone marrow showed marked resistance to the infection. Diffuse fibrosis occurred in these spaces in most cases, affecting the gray and the red marrow alike. There was some osteogenesis adjacent to the suppurating focus, this Lindsay considers a reaction in the marrow, which is not true osteomyelitis but an evidence that adequate defense is created against infections and destruction by infections. In only 1 case did bilateral osteomyelitis occur as a terminal lesion.

From his basic studies and from his clinical experience Lindsay draws some pertinent conclusions. He stresses the value of roentgen findings as an aid to diagnosis. He holds that adoption of the safest means of procuring drainage from a closed abscess is a necessity. He remarks that it is evident from the histologic observations that no single operative procedure is suitable for all cases of petrositis and that it is necessary to adopt a systemic approach that will avoid overlooking any localized area of disease. The complete exenteration of the mastoid cells is the first essential, including a careful search for tracts that might lead into the petrosa and exposure of the dura of the middle and the posterior fossa. Referring to his cases 5, 6 and 7, he advocated the elevation of the dura beyond the arcuate eminence in the middle fossa. These procedures may fail to reach suppuration in the apex, and Lindsay's histologic findings and his clinical experience indicate that an apical abscess is most frequently not accessible from the mastoid. The presence of fistulas opening into the middle ear may allow spontaneous recovery or when found at operation may lead to the focus in the apex. Lindsay used a combination of the technics advocated by Eagleton, Ramadier, Kopetzky and Almour. Certain other extrapetiosal methods of surgical approach might be found suitable in a case of large erosions of the intracranial surface of the pyramid or of a break through the inferior surface. However, Lindsay states that there can be no question of the desirability of securing drainage from the suppurating focus in the pyramid before intracranial extension has taken place. When surgical intervention is delayed until rupture of the cortex takes place

meningitis may ensue. The intrapetrosal method of draining an abscess at the mouth of the eustachian tube was used by Lindsay in 4 cases with satisfactory results. With his contentions, I find myself in accord, with reservations regarding the exposure of the dura of the middle and the posterior fossa during the first step—the simple mastoidectomy. I would reserve the dural exposure for use in cases in which extradural accumulations of pus were suspected.

The discussion following the contribution of Lindsay brought a report from Hagens,¹ who found osteomyelitis of the petrous apex in 3 cases, while Galloway¹ also recommended that one should endeavor to make a diagnosis not of petrositis but of the part of the petrosa involved, thus facilitating the selection of the operative approach in the given case.

Lund⁶¹ elucidates the significance of symptoms. He states that ocular and retrobulbar pain are more apt to point to osteomyelitis of the anterior supralabyrinthine cells, while pain in the neck and the deep muscles of the neck suggests involvement of the sublabrynthine region. Palsy of the sixth nerve is not bound up solely with apicitis but can—as all otologists know—result from thrombosis of the superior or the inferior petrosal sinus or of the cavernous sinus. Attention should be paid to disturbances in taste for the localization of lesions in the petrosa. Anterior supralabyrinthine petrositis involves the anterior two thirds of the tongue, because of interference with the chorda tympani in its course through the facial canal, whereas sublabrynthine lesions cause disturbances in taste in the posterior third of the tongue, due to involvement of the glossopharyngeal nerve. In anterior petrositis the lesion may encroach on the carotid plexus and result in pupillary changes. Lund makes the pertinent observation, “The triad of Giadenigo has finished its role and has been replaced by the minutiae of the various combinations of symptoms in the diagnosis.” With this statement I am fully in accord. In the matter of differential diagnosis, Mayer⁶² advances significant data. On the basis of his personal experience he states an important means of diagnostic differentiation between an extradural abscess over the tegmen tympani resulting from mastoiditis and one resulting from petrositis. The lesion in the first instance may present an intense headache, but it is not localized either intraorbitally or supraorbitally as in the second instance. Laskiewicz⁶³ makes an important diagnostic distinction between two forms of osteomyelitis of the temporal bone in infants. One is the type in which septic symptoms appear early,

61 Lund, R. Petrositis, *Zentralbl f Hals-, Nasen- u Ohrenh* 30 208, 1938.

62 Mayer, O. Die Pyramidenzellenerkrankung, *Ztschr f Hals-, Nasen- u Ohrenh* 42 87, 1937.

63 Laskiewicz, A. Sur l'osteomyelite petrosquamo-mastoïdienne chez les enfants, *Rev de laryng* 59 342, 1938.

with swelling extending from the ear to the eyelids, adenitis in both the anterior and the posterior cervical region and often multiple thrombophlebitis and mastoiditis. The second type is osteomyelitis of the petrous apex which starts with headache. Mundnich⁶⁴ discusses the significance of trigeminal pain. In the early work on petrositis, great stress was laid on pain and its regional intensities. Later, alterations were recorded. In Mundnich's case mastoidectomy for subperiosteal abscess was done in 1933. One month later severe headache developed on the left. The mastoidectomy was revised without yielding any significant findings. For two years a postauricular fistula persisted and suppurated. During this interval there was no pain. The patient then suffered from an attack of grip and died of purulent leptomeningitis. The autopsy showed, besides the latter condition, a large extradural abscess in the middle cranial fossa. The histologic findings revealed complete coalescence of the entire petrous portion of the temporal bone, anterior to the superior semicircular canal. The gasserian ganglion was bathed in pus. Degeneration of some of the ganglion cells and nerve bundles also was demonstrable. Mundnich discusses three possible explanations for the absence of pain. 1. The damage noted in some of the axis cylinders might account for the loss of function. 2. Only the perception of pain may have been destroyed, while the other functions of the nerve remained normal. 3. The patient may have been so constituted that he could readily stand pain. The observer contributes the suggestion that other tests for involvement of the fifth nerve should be employed, and might prove useful, in the diagnosis of petrosal lesions, among which corneal reflexes and perception of cold and heat come into account. This suggestion parallels that of Lund, which has been cited. I may add that this case proves the danger of permitting a persistent postauricular fistula to discharge pus for two years without surgical intervention. The supervening influenzal infection had a ready path toward the cranium.

The routes of rupture of petrous lesions are discussed by Maspétiol⁶⁵. Such ruptures may take place under the labyrinth, behind the styloid process and along the fossa and tract in which run the great vessels of the neck. When the extrapetrosal collections of pus manifest themselves as a pharyngeal abscess, he recommends opening by an incision along the anterior portion of the sternocleidomastoid muscle. A focus within the apex proper may rupture along the musculature of the soft palate, it may follow the eustachian tube and appear near the tubal orifice, or it

64 Mundnich, K. Ueber Ursache und Bedeutung otogener Trigeminus Schmerzen, Arch f. Ohrenh. **144** 259, 1938.

65 Maspétiol, R. Contribution à l'étude des suppurations exocrâniennes d'origine otitique. Les abcès secondaires aux pétrosites, Ann. d'oto-laryng., 1937, p. 790.

can cause a swelling on the vault of the nasopharynx. Maspetiol mentions the possibility that extradural pus may find the way through one of the natural openings, like the foramen lacerum or the jugular foramen and thus reach a point outside the skull. Of course, the knowledge of these possibilities is important, and such ruptures have all taken place at some time or another. What is more important, however, is that the lesion shall be diagnosed while it is still unruptured, while it is still intrapetrosal, and surgical intervention should be adapted to reach its site.

Kelemen⁶⁶ reported on 2 cases of severe otitis in which osteomyelitis of the petrous pyramid developed, in both of which autopsy was performed and the lesions histologically examined. Kelemen holds with Mayer that the infection never originates in the marrow spaces but always spreads to them from the air spaces. This observation finds support in that of Lindsay,⁶⁷ which has been cited, that the infection always spreads from the pneumatic spaces to the marrow, the latter always showing marked evidence of resisting the spread of the infection. The only contrary point of view that I have been able to find in this year's literature is in the report of Palestini,⁶⁸ who contributes a study of 5 cases, in 3 of which the patient recovered. On the bases of his pathologic study at autopsy in the other 2 cases, he concludes that the spongy bone marrow, which he believes exists at all ages, is easily infected.

Richter⁶⁸ reports on the autopsy in a case of apical empyema of the petrous pyramid in a 66 year old patient, who died of meningitis after an otitic infection which lasted five weeks. Extensive pneumatization of the pyramid was found, involving all the cells in the suppurative process. There were multiple extrapetrosal ruptures—two through the tegmen to the dura of the middle cranial fossa, one from the retrolabyrinth to the dura of the posterior fossa and one into the internal auditory meatus. Another interesting postmortem observation comes from the report of Yamakawa and Kawano⁶⁹ of the case of a 29 year old patient suffering from aural discharge for five days. The only other symptom was headache. Streptococcal meningitis developed, and death followed.

66 Kelemen, G. Osteomyelitis of the Petrous Pyramid, *J. Laryng. & Otol.* **53** 113, 1938.

67 Palestini, E. Rilievi anatomopatologici sulle così dette petrositi, *Valsalva* **14** 213, 1939.

68 Richter, H. Beiträge zur pathologischen Anatomie des Ohres. Mehrfache Spitzenempyeme des Felsenbeines mit mehrfachen Einbrüchen ins Schädellinnere, u. a. in den inneren Gehörgang, *Arch. f. Ohren-, Nasen- u. Kehlkopfh.* **141** 334, 1937.

69 Yamakawa, K., and Kawano, N. Early Rupture of an Apicitis, *Otologia* **10** 901, 1937.

At operation the mastoid process was found uninvolved. At autopsy both gross and microscopic studies revealed that the cells of the petrous tip were initially involved. This empyema of the tip eroded the bone and ruptured into the middle cranial fossa. I have always taught that petrosal suppuration was not a complication of mastoiditis but rather of purulent otitis media. These observers further substantiate this contention.

Cheridjian⁷⁰ reports on a case of petrositis in an infant of 7 months in whom bilateral purulent otitis media had developed. Mastoidectomy was done on one side. Death ensued, and at autopsy extensive pneumatization was observed which reached the apex on both sides. All the cells were filled with pus, which also bathed the vestibular and cochlear branches of the eighth nerve. This nerve on histologic examination was seen to be edematous and hyperemic. The report is interesting first, because of the extensive pneumatization, reaching to the tips, in so young a subject. I doubt the interpretation of the autopsy because of the second observation, namely, that all the spaces up to the tip were filled with pus. In view of this, unless a lining membrane was demonstrable coating the trabeculae, how was it possible to differentiate the air-containing spaces from those which normally would have contained marrow? In view of the purulent invasion of these spaces I am inclined to doubt the finding of complete pneumatization of the petrous portion of the temporal bone in a 7 month old infant.

Moorhead⁷¹ read a paper before the Eastern Section of the American Laryngological, Rhinological and Otological Society, which he subsequently published with a coauthor (Moorhead and Baker),⁷² in which 30 consecutive cases of petrosal suppuration are given with considerable detail. Moorhead describes a slightly modified Eagleton technic, which he employed in all his cases. In 8 of the cases meningitis was present when the surgical intervention on the pars petrosa was undertaken. In 4 cases a preoperative diagnosis of petrosal involvement was not made. It would take me too far afield to discuss in detail each of the 30 cases comprising Moorhead's report. It suffices to recommend to the serious student a study of the original communication, to be read against the background of current otologic opinion. The paper takes on

70 Cheridjian, Z. Comportement des voies cochléaires et vestibulaires périphériques dans une panpétrosite bilatérale chez un enfant de sept mois, *Rev d'oto-neuro-ophth* **15** 666, 1937.

71 Moorhead, R. L. Petrous Pyramid Suppuration. When and How to Operate (with a Report of Thirty Cases), *Tr Am Laryng, Rhin & Otol Soc* **44** 254, 1938.

72 Moorhead, R. L., and Baker, J. P. Suppuration of the Petrous Pyramid. When and How to Operate. Report of Thirty Cases. *Arch Otolaryng* **28** 497 (Oct) 1938.

added importance because it received full support from Friesner⁷³ in the discussion which followed its presentation. The latter quoted numerous extracts from his own contributions in substantiation. Moorhead's report contains a polemic discussion of his symptomatology, contrasting his observation to what is recorded "in literature." He has not, however, separated the signs and symptoms in his cases which arose from meningitis from those which came from the petrosal lesion. It is well known among clinicians that once meningeal infection is established, the symptoms from this overshadow and dominate the clinical picture, so that the less intense signs from an intrapetrosal lesion are obscured. In most of Moorhead's cases rupture occurred before operation, and extradural collections of pus are frequently noted. The possibility of a spontaneous rupture of pus from the pyramid through the tubotympanic area is almost negatived, Friesner stating in substantiation that his own post-mortem examination of 30 lesions of the petrosa gave this observation only once. Nevertheless, the numerous reports of competent observers who recorded many such findings years before petrosal lesions were recognized clinically cannot be negatived by one man's opinions, and even Moorhead reported 1 anterior labyrinthine lesion with spontaneous rupture into the pharynx while 1 of his autopsy reports would lead the reader to suspect the presence of another such lesion.

In many of his operations, Moorhead added puncture and withdrawal of fluid from the pontile cisterna. His rationale for this is not entirely clear, since in some cases of fully developed meningitis the cisterna was not tapped, while in others it was. It is to be regretted that a comparison of the bacterial content of the fluid drawn from the cisterna by puncture with that observed by lumbar puncture was not reported. It would have substantiated or failed to substantiate a contribution made by Eagleton, who contends that in many cases pathogenic bacteria may be obtained by cisternal puncture while the fluid withdrawn by lumbar puncture still remains clear.

Moorhead's paper contains also a strong plea for the avoidance of radical mastoidectomy in order to conserve the hearing, and his presentation contains many audiometric records to prove his point. During the further discussion of this paper Kopetzky⁷⁴ drew attention to the lack of parallelism between the hearing which remains after radical mastoidectomy for chronic suppurations of the middle ear, which generally are of long duration, and that after radical mastoidectomy for an acute lesion, of short duration. In the first instance, most of the loss of hearing takes place in the long years during which the chronic condition has existed, and only to a degree does the radical mastoidectomy further produce it

⁷³ Friesner, I, in discussion on Moorhead,⁷¹ p. 289

⁷⁴ Kopetzky, S. J., in discussion on Moorhead,⁷¹ p. 288

If petrosal lesions can be handled successfully surgically, with conservation of hearing, every one will concede that an advance in surgical therapy had been achieved. Three factors must be considered when one evaluates this noteworthy endeavor.

1 It must not be forgotten that most of the competent students of the lesion under discussion are agreed that radical mastoidectomy is not necessary in many of the cases. Most of the postcochlear lesions can be reached without resorting to this operative technic. Thus the question of conserving hearing by avoidance of radical mastoidectomy is limited to cases in which the lesion can be reached adequately only by radical mastoidectomy as one step in the procedure.

2 Elevation of the dura is necessary to reach the lesions anterior to the labyrinth without entering the middle ear, and to do this, on the basis of conserving hearing, entails dangers, which add to the gravity of the condition. This factor has so often been stressed by me in these summaries and in other publications that I shall not repeat my remarks here. It suffices to recall Ramadier's contentions regarding this point, already cited, agreement with which will be found in the writings and opinions of most neural surgeons. In many of Moorhead's cases the added danger was absent, because the lesion had already ruptured extradurally and accumulations of pus were found at operation between the dura and the bone. Finally, Lindsay,⁶⁰ in case 9 of his report, did a radical mastoidectomy and evacuated pus from the apex of the pyramid by entering it between the cochlea and the internal carotid artery, and he reports an uneventful recovery with perception of a whisper at 2 feet (60 cm). I realize that Lindsay's single case does not establish a scientific criterion, yet it brings evidence on the question of radical mastoidectomy and its effect on hearing when employed for an acute condition in which the middle ear has not been involved for too long a time.

3 By avoiding entering the middle ear, does Moorhead invariably reach the location of the lesion, and does he eradicate it? This becomes a serious question when one reads his clinical histories of the lesions which terminated fatally and also of that which spontaneously ruptured from the anterior labyrinthine area into the pharynx. The observation at autopsy of "extensive necrosis" of the pyramid suggests that a Ramadier operation or an apicectomy might have eradicated this necrosed osseous tissue, and such intervention would have necessitated radical mastoidectomy as a step in the procedure. Finally, elevating the dura and making a hole for drainage from above into the petrosa is not the surgical answer to all types of lesions in the petrosal pyramid, as even Moorhead's cases demonstrate.

Moorhead's report, besides citing 8 cases of patients with distinct meningitis, shows that 7 patients had extradural abscesses and 1 had a

rupture into the pharynx. In 12 cases, the pontic cisterna was punctured and cloudy fluid withdrawn. Moorhead reports 20 recoveries and 10 deaths. Of the 10 patients who died he obtained permission for autopsy on 2. The autopsy records do not contain histologic observations. The statement is made that drainage of the pyramid was adequate. Nevertheless in case 3, the autopsy report notes "extensive necrosis" of the pyramid. The other autopsy, in case 9, gives no evidence as to the petrosal disease.

In view of the divergence present here, I am reminded of a pertinent observation credited to Balance,⁷⁵ who said,

Want of agreement among serious workers about a grave question of surgical treatment arises from the lumping together of clinical conditions having an essentially different pathological basis, or from essential pathological conditions not clearly understood. All true and lasting surgical practice is based upon pathology, and when once pathology of an affection is clearly appreciated, divergence of views as to treatment ought to disappear.

In the study of petrositis, so much stress has been laid on the disease produced by streptococcic and pneumococcic infections that invasions by specific organisms and by tumors are forgotten. Kleinfield and Smith⁷⁶ report the case of a 3 year old child who had symptoms referable to the ear but no objective otoscopic signs. One month subsequent to the appearance of symptoms, a large perforation of the drum appeared, and paralysis of the facial nerve developed. Radical mastoidectomy was performed. Although all tests for tuberculosis were negative, a tuberculous lesion was discovered post mortem.

Because roentgen examination is so important an aid to the diagnosis of petrosal lesions, it is germane to this summary to comment on this phase of diagnosis. Diagnosis should not be made on roentgenograms alone. With clinical symptoms to substantiate them, roentgen studies are invaluable in dealing with suppurative lesions. Because cases are being observed in which suppuration is absent, I have thought it advantageous to present a quotation from the contribution of Kraus,⁷⁷ according to whom a number of extrapetrosal processes attack the petrosa which in their commencement have meager otologic symptoms. He makes the following summation:

1 Destruction of the pyramid by malignant tumor of the epipharynx takes place from below, and roentgen examination reveals basal destruction first.

75 Balance, C, cited by Lillie, H. I. *Surgery of the Ear*, New York, Thomas Nelson & Sons, 1938, chap. 9, p. 262.

76 Kleinfield, L., and Smith, G. Tuberculosis of the Petrous Pyramid, *Ann Otol., Rhin. & Laryng.* **47** 261, 1938.

77 Kraus, L. Pyramidal Changes in the Roentgenograms, *Arch. f. Ohren-, Nasen- u. Kehlkopfheilk.* **142** 15, 1936.

2 The median parts of the petrosa are destroyed earliest and most completely, and because of this the roentgenogram often reveals steplike destruction

3 The anterior surface of the pyramid and the adjoining bones are destroyed much earlier than the posterior portion, particularly than the cortical portion of the posterior wall, which resists the longest

4 The first three points are readily explained by the position of the primary tumor and by the tendency of its growth

5 If the posterior pyramidal surface is intact, roentgen examination reveals a relatively clear outline of the apex, even if rather large portions of the anterior part of the pyramid are missing

6 If the posterior part of the cortex and the adjoining bone are completely or partly lacking, the roentgenograms show a complete defect of the petrosa or circumscribed lighter areas. If the defect is localized around the porus acusticus internus, this process is dilated

7 A lighter area in the central part of the apex in a case of malignant nasopharyngeal tumor may be the result of an inward growing of the tumor along the tube and its bony surroundings. An inflammatory peritubal process may thus be recognized by a lighter area in the center of the roentgenogram

8 Atrophy of the entire petrosa may be caused by severe medullary changes in the forms of active or passive hyperemia or by fibrous transformation of the marrow

9 The temporary absence and the reappearance of the apex in the roentgenograms can be explained by the changing calcium content. The change in calcium content, too, is probably caused by active and passive hyperemia. This fact probably applies to inflammatory processes as well as to those that are accompanied by stasis

71 East Eightieth Street

News and Comment

CASSELBERRY FUND AWARD

A sufficient sum having accrued from the Casselberry fund for encouraging advancement in the art and science of laryngology and rhinology is now available, in part or as a whole, for a prize award or decoration or to defray the expense of original investigation or research in the domains mentioned

Theses or reports of work must be in the hands of the secretary of the American Laryngological Association, Dr Charles J Imperatori, 108 East Thirty-Eighth Street, New York, before Feb 1, 1940

GENERAL NEWS

Examinations for Certification by the American Board of Ophthalmology—One written examination only will be given during 1940 for certification by the American Board of Ophthalmology This will be held on March 2 in various cities throughout the country, and applications must be filed before January 1 Applicants must pass this written examination satisfactorily before being admitted to oral examination The first oral examination will be given in New York on June 8 and 10 Candidates who are planning to take this oral examination must file case reports before March 1 The date of an oral examination to be held in the fall will be announced later

Application blanks may be procured from the secretary-treasurer, Dr John Green, 6830 Waterman Avenue, St Louis

CORRECTION

Through inadvertence, mention was not made in the article by Dr Jacob Ruchman entitled "Rhinosporidiosis (Seeber) First Occurrence in a Female in North America," which appeared in the August issue (*ARCH OTOLARYNG* **30** 239, 1939), of the fact that figures 1 and 2 appearing therein were taken from the article by Drs J G Pasternack and C S Alexander entitled "Rhinosporidium Seeberi An Etiologic Agent in the Production of Nasal Polyps," in the June 1938 issue (*ARCH OTOLARYNG* **27** 746, 1938)

Abstracts from Current Literature

Ear

THE INFLUENCE OF BLOCK ANESTHESIA INDUCED BY PROCAINE HYDROCHLORIDE ON THE DEVELOPMENT OF OTITIS AND ACUTE MASTOIDITIS A J BONDARIENKO, *Rev de laryng* **59** 836 (Nov) 1938

The author reasons that part of the disturbance in disease of the middle ear and mastoid is due to a neurotrophic influence. This is suggested by Wichnewsky, who treated otitis externa by injecting cocaine. The technic recommended is the injection of 8 to 15 cc of 0.25 per cent procaine hydrochloride over the mastoid process or in the preauricular region. At intervals of about four to six days this may be done a second and a third time. In a series of 103 cases the author had especially favorable results with catarrhal conditions and less favorable results with suppurative conditions. When the suppuration had gone on to destruction of bone the results were not favorable. In some of the cases the injection was followed by a reduction in the leukocyte count. The procedure is recommended as a conservative treatment of inflammatory processes of the ear, but it is not intended to supplant other curative methods used in these diseases.

BATSON, Philadelphia

DESTRUCTION OF FUNCTION OF THE INTERNAL EAR IN SCARLATINAL OTITIS E URBANTSCHITSCH *Monatschr f Ohrenh* **73** 1 (Jan) 1939

The loss of function of the internal ear in cases of scarlet fever is usually produced by serous labyrinthitis, even when there is severe suppuration in the pneumatic cells around the internal ear. When the condition is mild, repair of the function of the internal ear may be expected even when the patient is entirely deaf. In a large majority of cases of severe involvement, however, the normal function of the internal ear will not return. Particularly is this true when the patient has acute otitis media prior to the appearance of the exanthem and when otitis occurs soon after the appearance of the exanthem and the patient is in danger so far as the labyrinthitis is concerned. The fact that in scarlatinal otitis labyrinthitis is usually serous and seldom becomes purulent may be explained by the development of the scarlatinal antiviral within the body, producing greater resistance against the local suppuration. The author presents 4 cases and three photomicrographs accompany the article.

LEDERER, Chicago

THE JUSTIFICATION OF WILDE'S INCISION B SCHMIDT and P NASSUPHIS, *Monatschr f Ohrenh* **73** 24 (Jan) 1939

In acute otitis media of infants a swelling behind the ear may appear in the first few days or in the third to the fourth week. In the former case the infiltration penetrates along the connective tissue within the squamomastoid or the tympanomastoid suture into the subperiosteal space, and the simple incision suggested by Wilde is sufficient to empty the superiosteal abscess. In the latter case there is actual destruction of the lateral wall of the antrum and antrotomy is indicated.

LEDERER, Chicago

SEVERE INJURY TO THE REGION OF THE MASTOID F X KOCH *Monatschr f Ohrenh* **73** 66 (Jan) 1939

A girl 8 years old received a severe fracture in the region of the left mastoid process. A radical operation on the middle ear was performed, with wide exposure of the dura. An uneventful recovery followed.

LEDERER, Chicago

A NEW CONCEPTION OF THE DEFECT IN HEARING IN OTOSCLEROSIS AND PERHAPS
A NEW METHOD OF TREATMENT MAX MEYER, *Acta oto-laryng* 27 1, 1939

Meyer presents 6 cases of noninfectious progressive deafness, including 4 of typical otosclerosis, in which the patients were treated by a single puncture of the cisterna, by which 30 to 50 cc of cerebrospinal fluid was removed. In this much fluid did not flow naturally from the needle it was removed by a syringe.

A favorable influence on the hearing and on the tinnitus was experienced in every case. Scientifically interesting is the fact that a simple reduction of fluid tension in the internal ear improved the hearing and favorably influenced the subjective noises. The author thinks that these experiments are of theoretic interest also in demonstrating that the conduction deafness of otosclerotic patients is not caused solely by ankylosis of the stapes.

The procedure is of therapeutic interest because the hearing in the majority of the cases was considerably improved, sometimes even becoming normal, and because the improvement did not immediately recede. Whether the improvement will last long enough to be worth while only time will tell, because only six months had elapsed since the treatment in his first case. Therefore, the longest period of improved hearing among his cases was six months.

His studies further show that the lowering of the upper tone limit for air conduction is no certain sign of atrophy of the labyrinth, for in that condition the upper tone limit for bone conduction, as tested by means of the monochord, is often normal.

It is the author's belief that the deafness in these cases was due not so much to fixation of the stapes as to "hydrops labyrinthi."

GROVE, Milwaukee

Larynx

THE INDICATIONS FOR AND TECHNIC OF TOTAL LARYNGECTOMY LACLAU-LACROUTS,
Rev de laryng 59 913 (Dec) 1938

This is a report on 24 patients operated on between 1935 and 1938 by the technic of Prof G Portmann. Of these 24 patients 3 are here reported on for the first time. The advantages of the low preliminary tracheotomy are pointed out, as well as the special procedures used in the closure of the pharynx. There are a description of the operative findings in the various cases and a detailed summarizing table. In September 1938 19 patients were living, 13 apparently well.

BATSON, Philadelphia

BRANCH OF THE SUPERIOR LARYNGEAL NERVE AND THE FUNCTION OF THE CRICOTHYROID MUSCLE G E JANNULIS, *Monatschr f Ohrenh* 73 64 (Jan) 1939

Occasionally after puberty the voice does not become lower, but the puerile voice persists, supposedly because of an inverted action of the cricothyroid muscle. The author, therefore, paralyzes this muscle by the injection of procaine hydrochloride into the superior laryngeal nerve. The patient becomes accustomed to speaking with a natural voice, which he continues to use even when the analgesia of the nerve has disappeared. The author also succeeded, by the same method, in influencing the voices of castrated persons.

LEDERER, Chicago

Pharynx

DERMOGRAPHIA IN PATIENTS WITH ADENOIDS C CALABRESI, *Arch ital di otol* 51 94 (Feb) 1939

Previous studies of dermographia have led to false deductions, because the methods of investigation have been inaccurate. Contrary to previous opinions, Calabresi regards this reaction as a physiologic phenomenon. Recent investigations

tend to place dermographic reactions in the field of the neuroendocrine and the neurovegetative system, the index of sympathetic excitability being vasoconstriction, and of parasympathetic excitability, vasodilatation. Symptoms of functional alterations in the neurovegetative system in children with adenoids led Calabresi to examine the dermographic reflex in such patients. Using Cornel's apparatus, by which the pressure is accurately determined, he examined 114 subjects. The results of the examination were not conclusive, since in normal controls he found great variations in the reaction. The most that can be said is that a certain lability of the neurovegetative system existed in the subjects studied.

DENNIS, San Diego, Calif

PULMONARY COMPLICATIONS FOLLOWING TONSILLECTOMY Z SZOLNOKY, Monatschr f Ohrenh **73** 48 (Jan) 1939

The author has observed the following pulmonary complications after tonsillectomy. 1 Bronchitis. Among 100 patients, only 4 had normal temperature after tonsillectomy, the remainder had a fever for six to eight days, the temperature rising to 100.4 F. This rise of temperature is explained by the author as post-operative bronchitis. (Unfortunately he does not describe his technic of tonsillectomy. It would be of interest to know something about that, since his finding that patients have fever for six to eight days after the operation is not in agreement with the usual experience.) 2 Pneumonia. Among 3,000 cases, the author observed bronchopneumonia in 12. 3 Abscess and gangrene of the lung. This complication took place in 2 cases only. Both patients had the operation under local anesthesia and were adults.

In order to study the pathogenesis of the pulmonary abscess, the author performed the following experiments. After the surgical removal of the tonsil, he dropped 3 cc of iodized poppyseed oil into the fossa. After two minutes he observed the radiopaque area within the bronchi by means of a fluoroscope. He draws the conclusion from these experiments that the pulmonary abscess develops by aspiration of infectious material from the mouth into the lungs and is not produced by emboli within the blood vessels of the lungs.

LEDERER, Chicago

THE TREATMENT OF PAINS FOLLOWING TONSILLECTOMY WITH VITAMINS B₁ AND C M BAER, Monatschr f Ohrenh **73** 58 (Jan) 1939

The pains following tonsillectomy are due to the wound within the mouth. Therefore, morphine, particularly as a suppository, should be administered. The pains, which sometimes are late complaints after the operation, are combined with some disturbances in the vitamin balance. In such cases the administration of vitamins B₁ and C seems to be the suitable treatment.

LEDERER, Chicago

THE DIAGNOSIS OF LEUKEMIC DISEASE OF THE PHARYNGEAL ORGANS RUDOLF LAUB, Pract oto-rhino-laryng **2** 23 (Feb) 1939

The author reports 2 cases of lymphatic leukemia, in 1 following a peritonsillar abscess and in the other the extraction of a tooth, with a secondary tumor-like swelling resembling a malignant tumor at the base of the tongue.

In both cases the condition was extremely violent, rapidly progressive and fatal. The clinical findings were not apparent early. The diagnosis was not made until after examinations of the blood revealed the leukemic state.

The author stresses the importance of the association of disease in the pharyngeal organs, which may be the etiologic factor in a leukemic disease.

PERSKY, Philadelphia

Nose

EPHEDRINE IN A PHYSIOLOGIC VEHICLE AND LATERAL HEAD-LOW POSTURE IN TREATMENT OF THE NOSE AND SINUSES SIDNEY N. PARKINSON, J. A. M. A. **112** 204 (Jan 21) 1939

Parkinson describes a simple technic for the treatment of infection of the nasal sinuses. It consists of the use of a certain posture of the head and the instillation of a drug in a physiologic vehicle. Adequate aeration and free drainage follow, with a minimum of trauma, chemical and/or physical.

The technic is as follows. Preliminary shrinkage is first obtained by the use of an atomizer containing an isotonic solution of ephedrine. After five to ten minutes of waiting, the patient is placed in the lateral head-low posture, at which time ephedrine in Locke's solution or its equivalent is instilled into both nasal chambers, the two sides being treated simultaneously. Infants and small children can be held over one's lap. The posture is held for from three to five minutes. All the sinistral ostia of both sides are flooded by the solution. The head is then rotated to a face down position to permit the nasal contents to escape from the nostrils.

This technic is easy, practical and comfortable, with few if any untoward effects, and can be performed anywhere, for no special apparatus is necessary.

GORDON, Philadelphia

OBSCURE LOW GRADE CHRONIC INFECTIONS OF THE ETHMOID SINUSES. USE OF THE PROETZ DISPLACEMENT SUCTION FOR DIAGNOSIS. GEORGE E. SHAMBAUGH, JR., J. A. M. A. **112** 1226 (April 1) 1939

The author discusses the problem of low grade chronic infection of the ethmoid sinuses. He points out some of the difficulties encountered when an accurate diagnosis of this condition is sought. The displacement method of Proetz is said to have placed the diagnosis of low grade infection of the ethmoid sinuses on a new plane of accuracy, and the author developed a technic on the same principle for appraising the ethmoid sinuses more accurately. The procedure is as follows. After the nose and nasopharynx have been cleaned of any adherent secretions, the patient's head is hyperextended in the Proetz position, and 0.25 per cent ephedrine in physiologic solution of sodium chloride is instilled into both nasal passages. Alternate suction and release of suction are applied from four to six times in each nostril and a search made for frank mucopus recovered. Recovery of mucopus indicates suppuration of the ethmoid sinuses, regardless of a normal intranasal picture or what the roentgenogram may have disclosed otherwise.

Fifteen cases, divided into five groups according to symptoms, are briefly cited. The symptoms in each group are as follows: (1) pain and headache, (2) infection in a remote organ, (3) chronic and persistent cough, (4) frequent head colds and (5) fever of unexplained origin.

The conclusions are as follows: "1. The displacement method of promoting drainage from the ethmoid cells will establish a diagnosis in many cases of chronic low grade ethmoid suppuration that would otherwise be doubtful or missed entirely. 2. Displacement suction will clear up many but not all chronic ethmoid suppurations. 3. Chronic suppuration of the ethmoid sinuses may exist with slight or obscure local symptoms, the presenting symptom being headache of obscure etiology, systemic infection such as arthritis, iritis or neuritis, chronic cough, frequent head colds or fever of unknown origin."

GORDON, Philadelphia

THE PRESENCE OF KOCH'S BACILLUS IN THE NASAL MUCOSA. V. SANGIOVANNI, Arch. ital. di otol. **51** 57 (Feb) 1939

Investigations have revealed that in a percentage of normal persons the nasal and nasopharyngeal secretions contain tubercle bacilli. The percentage of secretions containing the organisms in persons with pulmonary tuberculosis is, of course, greater. The bacillus may reach the pituitary membrane from the

exterior, through the blood stream and by way of the lymphatic vessels. Implantation from the outside occurs from inhalation of infected dust, from the use of dirty fingers or handkerchiefs or from the projection of sputum above the soft palate during coughing in cases of advanced tuberculosis. Endogenous infection occurs in cases of extensive pulmonary tuberculosis as a terminal phenomenon, via the blood and lymph streams. The problem of penetration of the mucosa by the tubercle bacillus is obscure, but it is known that the pituitary membrane offers much resistance to infection. The presence of tubercle bacilli in the subepithelial tissue without clinical evidence of tuberculosis constitutes potential nasal tuberculosis.

Sangiovanni's investigations were made on 30 patients with open pulmonary tuberculosis with positive findings in the sputum, 30 patients with pulmonary tuberculosis with negative findings in the sputum and 20 normal persons. None had evident lesions of nasal tuberculosis. Secretions and scrapings from the mucosa were examined. In the first group Koch's bacillus was found in the nasal secretion in 26 per cent and in the scrapings in 20 per cent. In the second group the percentages were 6 in the nasal secretions and 16 in the scrapings. In the group of normal persons an occasional bacillus was found in only 1. The differences in the percentages for patients with closed pulmonary tuberculosis and for normal persons are explained by the assumption that the pulmonary infection had diminished the normal resistance of the pituitary membrane.

DENNIS, San Diego, Calif

OSTEODYSTROPHIA FIBROSA OF THE FACIAL BONES K. HELLMANN, *Monatschr f Ohrenh* **73** 40 (Jan) 1939

The author describes 4 cases of osteodystrophia fibrosa of the facial bones, but no illustrations accompany the article.

CASE 1—A boy of 16 had a swelling in the left cheek. Roentgen examination revealed a tumor within the left maxillary sinus. The tumor had grown together with the floor of the orbit. A Caldwell-Luc operation was performed, with recovery.

CASE 2—A youth of 18 had a thickening of the right frontal bone and the right superior maxilla. Roentgen examination showed that the right frontal and the right maxillary sinus were filled with a sclerotic bony tumor. Parts of the tumor were removed.

CASE 3—A woman of 21 had a tumor as big as the head of a child in the region of the cheek. At operation a big cyst was found, displacing the maxillary sinus and the ethmoid bone.

CASE 4—The patient had a swelling as big as an apple in the left cheek. At operation a tumor was found, containing many cysts.

LEDERER, Chicago

PLASTIC OPERATION WITH IMPLANTATION OF BONE AFTER OPERATION ON THE FRONTAL SINUS P. REHAK, *Monatschr f Ohrenh* **73** 45 (Jan) 1939

The history of a patient of 18 who had an operation on the frontal sinus after the method of Riedel is reported. After operation a deeply retracted scar developed. The scar was excised, and a plate of macerated bone of an ox was implanted. Three months after the operation the implanted bone was still in place.

LEDERER, Chicago

Miscellaneous

ACUTE ANTERIOR POLIOMYELITIS FOLLOWING TONSILLECTOMY AND ADENOIDECTOMY, WITH SPECIAL REFERENCE TO THE BULBAR FORM R. C. ELEY and C. G. FLAKE, *J. Pediat* **13** 63 (July) 1938

Reports of the bulbar form of acute anterior poliomyelitis following tonsillectomy and adenoidectomy have suggested that the procedure may in some manner

influence the entrance of the virus. A study of 418 consecutive patients with acute poliomyelitis adds further evidence of this possibility and strongly suggests that when the operation is elective it may be advisable to postpone it if poliomyelitis is prevalent. Eley and Flake offer the following information in support of this statement. Of 287 patients with spinal poliomyelitis, there were only 8 with a history of recent tonsillectomy and adenoidectomy. Of the 8 patients, only 3 acquired the disease between the seventh and the eighteenth day (the commonly accepted period of incubation of poliomyelitis) after the operative procedure. Of 131 patients with bulbar poliomyelitis, 17 had had the operation within twenty days prior to the onset of the illness. Fifteen of the 17 patients acquired the disease within the usual period of incubation. Statistical computations demonstrate that the occurrence of this number of cases within the given period cannot be attributed to chance or to the usual frequency of poliomyelitis. The clinical observations suggest that if the patient is harboring the virus at the time of the operation, traumatization of the tissues may enable it to gain entrance to the central nervous system by way of the lymphatic system or the blood stream or perhaps by direct neural extension. The fact that 1 of the patients acquired bulbar poliomyelitis after adenoidectomy without tonsillectomy indicates that it is not necessarily the latter operation which enables the virus to gain entrance to the central nervous system.

J A M A

NASAL CHANGES OBSERVED IN WORKERS IN CHROMIUM. GIORGIO MANCIOLI, *Arch ital di otol* 51 24 (Jan) 1939

This study is based on observation of 294 workers in chromium, of whom 34.93 per cent had ulceration of the septum and 21.57 per cent septal perforation. In recent years the wide use of chromium and its salts in industry has resulted in a large number of cases of poisoning. The respiratory tract is the pathway of entrance for the chromium vapor. The nasal changes are chiefly on the septum (Valsalva's area) and the head of the inferior turbinate. The other parts of the upper respiratory tract show inflammatory changes, and, in addition, systemic effects, chiefly degenerative changes in the liver and kidneys, are present. The nasal mucosa is covered with greenish crusts. During the period of ulceration the symptoms are meager: headache, especially in the evening, and slight burning in the nasal fossae. Some persons have a special sensitiveness to chromium, but usually the disturbances depend on the length of time the worker is exposed and on the sufficiency of ventilation and the adequacy of the precautions surrounding him. The location of the lesions is related to the course of the currents of the inspired vapor in the nose and to the fact that the nasal septum is lacking in mucous glands and is furnished instead with serous glands, which offer little opposition to the action of chromium. Necrosis of the cartilage is not followed by regeneration, the size of the perforation being only partially reduced by cicatrization of the mucous membrane. The greater the length of time the worker is exposed to the chromium fumes, the more extensive the lesions produced. Because of the paucity of symptoms, active propaganda for individual means of defense are necessary to control this occupational disease.

The mucosa is at first hyperemic, then it becomes grayish white, and rounded spots from 1 to 2 cm in diameter appear. These spots ulcerate and lead to destruction of the mucosa and cartilage, the perforations are round or oval, vary in diameter from 5 to 15 mm and have clean, smooth edges. Examined histologically, the membrane shows flattening and cornification of the epithelium, the cells of which are poor in nuclei and have a tendency to exfoliate easily. The tunica propria is swollen and infiltrated with lymphatic elements, and the glands are dilated. The hypertrophy and ulceration of the mucosa represent two diverse reactions of the tissue to the intensity of the stimulus, to the various resistances of the patient and to the bacterial flora eventually present. Prophylaxis is above all based on the perfection of means to obviate the diffusion of the fumes, preferably by suction hoods over the vats, the avoidance by the workers of putting

the fingers in the nose and the use of a protective nasal ointment of petrolatum or hydrous wool fat. The use of gas masks, gloves or nasal tampons has not been found practical.

DENNIS, San Diego, Calif

THE SONOROUS REFLEXES IN THE DOG G ZANZUCCHI, *Arch ital di otol* **51** 73 (Feb) 1939

This article is a description of the author's technic of operating on dogs for investigation of the sonorous reflexes through opening of an osseous semicircular canal.

DENNIS, San Diego, Calif

ROENTGEN EXAMINATION OF THE AREA OF THE LACRIMAL SAC AND THE TECHNIC OF THE ENDONASAL OPERATION ON THE SAC. REPORT OF CASES H BRUNNER, *Klin Monatsbl f Augenh* **100** 729 (May) 1938

Brunner reports some impressions gained after performing 32 endonasal operations for removal of the lacrimal sac. The technic, described in detail, follows the routine of West and Kofler, with the exception that the medial wall of an ectatic lacrimal sac is not excised but is divided into four flaps, after the method of O Mayer, the sac is filled with physiologic solution of sodium chloride prior to this procedure. The author considers the number of personal operations of this type too small for the conception of a definite opinion as to the value of the method. He points out in this connection that some statistics may be misleading because the outcome is not considered. Brunner adds endonasal roentgen examination to the usual parts of the examination, this permits the operator to gain a satisfactory view of the anterior portion of the nasal skeleton which cannot be obtained by the usual general exposure of the skull, and it facilitates the control of the size and changes of the operative opening in the bone. This opening begins to grow smaller, in some instances nine months after the operation. Therefore, a large osseous opening is recommended by Brunner, who agrees with Toti in this respect. A number of roentgenograms and accompanying sketches illustrate this procedure and furnish proof that small osseous openings are responsible for recurrences. The condition of the soft tissues, on the other hand, may lead to the formation of granulation tissues, even in the presence of a large osseous opening. Attention is drawn to Kofler's suggestions, which should be followed. The results of postoperative treatment seem to be improved by the local use of alcohol.

K L STOLL [ARCH OPHTH]

INJURY TO THE INTERNAL CAROTID ARTERY IN THE SULCUS CAROTICUS KAYSER, *Ztschr f Hals-, Nasen- u Ohrenh* **44** 377, 1938

The author cites a case of fracture of the skull which was followed by often repeated profuse attacks of epistaxis. The causative factors were unknown, and the epistaxis still continued after ligation of the external carotid artery.

Five months after the accident, the patient succumbed after severe nosebleed. Postmortem examination showed that the internal carotid artery was torn in the region of the sulcus caroticus. The author points out the difficulty in exact diagnosis and the consequent inability to give proper treatment.

PERSKY, Philadelphia

POLYARTHRITIS, TONSILLECTOMY AND AUTOGENOUS VACCINES LAVAL, *Ztschr f Hals-, Nasen- u Ohrenh* **44** 381, 1938

The author reports the results of his treatment of a series of 20 patients suffering from polyarthritis in both the acute and the chronic form. He recommends tonsillectomy and the use of an autogenous vaccine made from the tonsils. In this small series he obtained cure in 11 cases and arrest in 2.

He believes that this form of therapy is valuable for both the acute and the early chronic form, but when permanent contractures have occurred supplemental physical therapy must be employed, and he stresses the necessity for the internist, in his treatment of rheumatic arthritis, to have the cooperation of the rhinologist

PERSKY, Philadelphia

A DISCUSSION OF AGRANULOCYTOSIS HISTOLOGIC OBSERVATIONS IN THE TONSILS AND EARS AND INDICATIONS FOR TONSILLECTOMY GRAHE, *Ztschr f Hals-, Nasen- u Ohrenh* 44 383, 1938

The author reports 8 cases of agranulocytosis, in 2 the condition was apparently due to injections of arsphenamine and a bismuth preparation, and in 6 it occurred in the course of an infection, usually angina with a peritonsillar abscess, in 1 of the latter 6 it was complicated by gripal otitis media. There were 5 deaths and 3 recoveries.

Tonsillectomy was performed in 7 of the 8 cases, usually when the agranulocytosis took its origin in angina and when necrosis had not become apparent. When necrosis has become apparent, the tonsillectomy should be performed only after the blood picture has improved.

PERSKY, Philadelphia

THE CAPACITY FOR RESORPTION AS ONE OF THE FUNCTIONS OF THE LYMPHO-EPITHELIAL TISSUES K. SAH, *Ztschr f Hals-, Nasen- u Ohrenh* 44 426, 1938

The author has done some experimental work in which he observed that the secretions of the mucous membranes of the sinuses can be transmitted through the lymphatic system directly to the tonsils, and in consequence that the first site of the reaction of the body to any irritant or infection by a micro-organism or a macro-organism is often the lymph nodules, the lymph sinuses or the epithelial tissue of the tonsils.

Further to substantiate this observation the author cites the case of a woman who had been taking granules of activated charcoal because of a gastric disorder for four years. In examining her because of a tonsillar infection, he found charcoal granules imbedded in the interstices of the tonsillar tissue, particularly in the lymph spaces, the lymph nodes and the loose and adventitious tissues about the blood vessels. He assumes that the granules were carried by the lymphatic channels and deposited in the tonsils. The presence of these granules in the tonsil may either act as an inflammatory agent or produce necrosis, an atrophic state or, finally, a fibrotic state. He believes that this case definitely substantiates his experimental work on both the permeability of the tonsils and their role as a reservoir.

PERSKY, Philadelphia

Society Transactions

AMERICAN LARYNGOLOGICAL ASSOCIATION

GEORGE B WOOD, M D, *President*

Sixty-First Annual Congress, Rye, N Y, May 24-25-26, 1939

CHARLES J IMPERATORI, M D, *Editor of Abstracts*

PRESIDENT'S ADDRESS DR GEORGE B WOOD, Philadelphia

The American Laryngological Association since its foundation in 1879 has remained not only the senior society but also the leading society in the United States for the development of laryngology and rhinology. Its fellows consist of a selected group of specialists, whose scientific and clinical work has brought American laryngology to the proud position it holds today. Not only have the fellows of the past left the abiding prestige of high endeavor, but the younger members are showing themselves capable and active, assuring the association's future success. It is recognized that high achievement has made this association an organization proud of its accomplishments, but the years of happy comradeship have developed a sympathetic friendship that has made the annual gatherings resemble a family reunion.

The essential feature of its organization is the election of a council for one year, the election being conducted in a manner which makes impossible any political activity in the selection of officers. From its foundation, this society, while believing thoroughly in the value of free discussion and debate, has been careful to avoid any radical publicity, and it recognizes the importance of preserving a high standard of professional ethics. The limited membership and the unusual care exercised in the acquisition of new fellows guarantee its future.

I urge on the fellows at this time the necessity of contributing their best work to the annual meeting. The association has a tradition of conservatism which is a firm foundation for whatever building the coming years may require, but it is hoped that the architecture of its heritage will remain worthy and beautiful, consistent with the past and present.

HISTOGENESIS OF THE TONSIL DR GEORGE B WOOD, Philadelphia

It is believed that because the anlage of the tonsil is essentially epithelial, because the lymphoid cells of the tonsil appear first after evidence of hyperplasia of the basal cells of the epithelium and because morphologic reasons for believing in the epithelial origin of these lymphocytes exist, the cryptal epithelium of the tonsillar tissue must be looked on as a source of lymphoid cells. The evidence for this belief is based chiefly on the study of tonsillar development in pig embryos.

PREVENTION OF SEPTAL HEMATOMA AFTER SUBMUCOUS RESECTION DR WILLIAM B CHAMBERLIN, Cleveland

In spite of the most careful operative technique and accurate hemostasis, hematoma is likely to follow submucous resection. Most operators use clamps, petrolatum gauze packing or some form of the Bernay sponge. These are removed usually in twelve to twenty-four hours. Nevertheless, hematoma is likely to occur. It seems to be less frequent if a perforation has occurred in one of the flaps. Various types of drain, inserted diagonally from the incision toward the base of the sphenoid,

have been tried but found wanting. There seems to be no sure way of prevention of hematoma. If and when it occurs, aspiration through the incision is probably the best treatment. If it is carried out with aseptic precautions and care, abscess is not likely to follow.

DISCUSSION

DR RALPH A. FENTON, Portland, Ore. I agree with the essayist on the extreme importance of preventing the onset of hematoma, because it nullifies, as all realize, the results of an otherwise excellently conceived operation. In this connection, if I might be permitted, I should like to show what has been attempted in that regard over twenty years. Instead of a drain being placed between the flaps, an incision is made high and far back on the side opposite the incision at the base, where hemorrhage is likely to occur from the region of the rostrum of the sphenoid, and the inside, between the flaps, is then painted with compound tincture of benzoin U. S. P. The inside of the flaps must be completely dry. The interior is always inspected carefully with Mosher's extensible nasal speculum. A piece of cellophane about 2 inches (5 cm.) square and greased with petrolatum is then placed on the same side as the incision. This is inserted in the nose between the wings of the ordinary nasal speculum far enough back so that packing can be readily carried out within this cellophane lining. That presses the entire septum over to the opposite side so that it is not necessary to pack the opposite side at all. Since that technic has been used, little difficulty with hematoma has been experienced. It does not seem to be necessary to pack both sides.

DR HENRY M. GOODYEAR, Cincinnati. I believe that Dr. Chamberlin has brought up an important point in the treatment of hematoma of the septum. One point that I should particularly like to mention is the use of tubes after submucous resection. Ribbed tubing about $\frac{1}{4}$ inch (0.6 cm.) in diameter is suitable. Strips $2\frac{1}{4}$ or $2\frac{1}{2}$ inches (5.7 or 6.4 cm.) long are cut and laid in so that they come to the end of the nose. It is only occasionally that these tubes stop up on both sides. The patient is permitted to draw back on these tubes and keep the mucus out of them during the first day, and of course they are removed with the packing at the end of the first twenty-four hours. If the tubes stop up, they may be cleaned out. I do not think that a nose should be packed so that a patient cannot breathe. If one holds one's nose closed and tries to drink a glass of water, after one has downed a single glass one will sympathize with the patient who has to try to swallow with his nose blocked for twenty-four hours.

DR JAMES A. BABBITT, Philadelphia. Within the last year or two, it seems that most laryngologists in Philadelphia have accepted the plan of omitting any packing in operations on the ethmoid and sphenoid sinuses and in Caldwell-Luc operations. It was not felt until recently that this was entirely safe. I cannot help feeling that the packing of the nose, with the slough which forms and a little undue pressure that so easily comes, invites infection and complications. I have the feeling that somebody is going to find exactly the type of pressure—splint, tube, packing or something of that sort—that barely covers the hemorrhagic area.

I am quite in accord with Dr. Goodyear's plan of making a drainage. It seems to me that the ideal method would be one or two insertions of a simple through and through suture in the septum, merely to keep the flaps together. The sutures do not even need to be tied, for there will be enough pressure from packing in a rubber glove finger.

DR WILLIAM WESLEY CARTER, New York (by invitation). In regard to hematoma I wish to say in the first place that I believe that hemorrhage after the submucous operation can be prevented to a large extent by the manner in which the mucous membrane is elevated from the septum. The elevator that I devised is a curet with its tip slightly out of the straight line. When its tip is

kept closely against the septum and the elevation is made gradually up and down, the vessels which are always outside the deeper layer of the mucous membrane are not injured

Should a hematoma occur, I always regard the cavity as infected. It has been my custom to evacuate the blood clot, take a swab, dip it in pure phenol, swab out the entire cavity and then immediately apply 95 per cent alcohol. Compression is not used after this procedure.

DR HORACE NEWHART, Minneapolis. The following suggestion came to me as a result of several hematomas which occurred within a short period. The standing orders in the hospital with which I am associated include a liquid or soft diet subsequent to the operation. The act of mastication of hard food or of gum chewing seems to be a factor in the production of hematomas.

TUMORS OF THE MAXILLAS AND THE MANDIBLE DR THOMAS E. CARMODY, Denver

In connection with benign tumors, including papillomas, fibromas and lipomas, one must consider location and incidence, removal by different methods, the possibility of occurrence, the possibility of their becoming malignant and the effect on the patient's mind. A consideration of malignant growths of the mouth and adjacent structures includes the types of malignancy, the tissues involved, diagnosis by dentist or physician, the effect on the general system, metastasis, the necessity of proving metastasis before operation as influencing prognosis, the methods of removing the growth and treatment by irradiation.

DEFECTIVE SPEECH IN RELATION TO DEFECTIVE HEARING DR MAX A. GOLDSTEIN, St. Louis

This article will be published in full with discussion in a later issue of the ARCHIVES.

REPORT OF A CASE DR CHARLES J. IMPERATORI, New York

The patient is 18 years of age. When he was 3 years old, he came to the clinic of the Manhattan Eye, Ear and Throat Hospital suffering from papillomatosis of the larynx. At that time, radium was being used for various purposes, and radium was inserted into the child's larynx. The results were perichondritis followed by stenosis of the larynx. In the course of time tracheotomy was done.

The papillomas recurred, and they were removed many times. Incident to the various removals, applications of radium and other measures, complete stenosis of the larynx developed. An internationally known laryngologist, who was visiting New York at that time, performed laryngostomy on him but unfortunately with complete failure. During my absence on a vacation, another laryngologist, in New York, did another laryngostomy on him, which also failed completely.

During the various operations, whether by the foreign laryngologist or the local laryngologist, his cricoid cartilage was partially destroyed.

I saw him again two years ago, and at that time, after speaking with Dr. Jackson about his newer method, the use of core molds, I bored a hole with a stilet through the cicatricial tissue and introduced a small core mold, no. 16. In the course of time, I was able to increase the size of the core mold to no. 28, but unfortunately I resigned from the institution at which the boy was being treated and again lost track of him. I saw him again a year ago, and I started dilation with the core molds and now have succeeded in getting the dilatation up to the point at which a no. 38 core mold is admitted.

This case is presented to bring out the following points: first, the disastrous results attending the use of radium within the larynx; second, the poor results obtained at times by laryngostomy, the underlying cause, of course, in this instance

being the destruction of the cricoid ring, third, the good results that may be obtained by the use of the core molds, as suggested by Chevalier Jackson

This boy, incidentally, has a good pharyngeal voice

The advice of members of the American Laryngological Association is sought regarding any further surgical procedure

Shall the cartilaginous implantation he has on one side of his larynx be removed, or shall he have a plastic, that is, a bridge type, operation, or what shall be done?

He is wearing a tracheotomy tube, and he has a no. 38 core mold in his larynx at present

(The patient then demonstrated his pharyngeal voice)

DEMONSTRATION OF METHODS OF TAKING COLOR PHOTOGRAPHS OF THE LARYNX DR GABRIEL TUCKER, Philadelphia

HEADACHES FROM PATHOLOGIC CHANGES IN THE NOSTRIL OR OTHER CAUSES DIFFERENTIAL DIAGNOSIS DR T. ROY GITTINS, Sioux City, Iowa

This article was published in full in the October issue of the ARCHIVES, page 589

DISCUSSION

DR EUGENE E. LEWIS, Los Angeles (by invitation) My convictions have crystallized rather definitely along the line of regarding the pains, attacks and troubles which have been mentioned in much the same light as that in which one can regard colic. I do not know why the concept of colic cannot be extended from hollow viscera to other structures, vascular structures, for instance. I am quite sure that I have witnessed in patients with such conditions a building up of a constitutional or compositional body which is characterized by certain properties dependent on the constitution at the moment. Those properties become apparent by the nature of the patient's reaction to the stimulus of the moment. The interaction between his environmental composite and his organic composite of the moment is characterized by pain or by some other response.

I am sure that if physicians can undertake to drop back into medicine far enough to forego localism for the present and study the disturbance of that set of general conditions which is manifesting the properties that are subjectively characterized by pain, local pain in the head and in the sinuses, for instance, and take steps to disturb the actual material composition to the point of unsettling the present combination of properties, they will go a long way toward avoiding misconceived local measures and approaching better conceived general measures.

DR RALPH A. FENTON, Portland, Ore. I must agree with many of the conclusions of Dr. Gittins' excellent presentation. I should like to ask him whether he includes in the diagnosis of migraine only those conditions arising from the various allergies or whether he includes under the head of vasomotor headaches some of those which may arise from disturbances elsewhere in the sympathetic system than in the head. I assume that he does the latter, because I think many laryngologists have noted that pains arising from the pressure of a swollen middle turbinate against a deflected septum come at the time of the climacteric and are related to the presence of fibroids or other pathologic conditions of the uterus or perhaps are related also to and coincide with the presence of mucous colitis and similar conditions.

DR T. ROY GITTINS, Sioux City, Iowa. In answer to Dr. Fenton, I have asked many physicians to tell me what to call such headaches. I have mentioned vasomotor headaches without knowing what they are. I have never been able to find out. I mentioned vasomotor, allergic and migrainous headaches. Migraine is a disease, of course, that includes a whole group of conditions reported on in the literature with record of symptoms. Pathologic changes do not precede or follow the syndrome, and I simply do not know what to call it. In some instances it may be allergic.

A NEW ANATOMIC AND FUNCTIONAL SYSTEMATIZATION OF THE CERVICAL CONNECTIVE TISSUES THE PERIPHARYNGEAL AND POSTVISCERAL SPACES DR JOSEF D WEINTRAUB, Cincinnati (by invitation)

ANATOMIC-PATHOLOGIC STUDIES OF RETROPHARYNGEAL ABSCESS DR SAMUEL IGLAUER, Cincinnati

These articles will be published in full with discussion in a later issue of the ARCHIVES

INTRANASAL DACRYOCYSTOTOMY DR W E SAUER, St Louis

This article will be published in full with discussion in a later issue of the ARCHIVES

MANAGEMENT OF CICATRICAL STENOSIS OF THE LARYNX DR JOHN H FOSTER, Houston, Texas

The object of this paper is not to offer any new methods of dealing with cicatricial stenosis. The advantages and disadvantages of the various methods advocated are considered, and an attempt is made to determine the procedure best adapted to the varied conditions met with in private practice. The saving of time by the use of thyrotomy and skin graft in certain cases is stressed. Attention is called also to the advantage of replacing and anchoring the separated ends of the cricoid cartilage.

DISCUSSION

DR JOSEPH B GREENE, Asheville, N C The one type of stenosis to which the essayist did not refer is tuberculous stenosis. I have in mind conditions due to scar tissue in either the anterior or the posterior commissure. I have 3 patients in mind that have lived for a number of years. They are perfectly satisfied and comfortable after tracheotomy.

I believe Dr Jackson agrees that dilation in such cases of stenosis is unsuitable. I have in mind a patient whom I referred to some years ago, he abstained from surgical treatment in that case. It is apt to activate the tuberculosis in such cases.

I may mention a case that Dr Fletcher Woodward reported a few years ago, not before this association, in which he operated on a tuberculous patient successfully, but in spite of that instance of a favorable result from surgical treatment, I am still inclined to the opinion that tracheotomy offers the patient the best satisfaction and comfort.

I recall a patient living in my city at this time, a patient of Dr Chamberlin, who was subjected to tracheotomy twenty years ago and is still comfortable with a tracheotomy tube.

DR GORDON B NEW, Rochester, Minn Dr Foster stated that the use of a skin graft is a shorter method of taking care of laryngeal strictures. It is a principle of plastic surgery that if a skin graft is used to line a cavity, pressure must be kept over the graft for a long time to prevent contraction, particularly in the correction of laryngeal strictures by excising the scar and replacing it with a skin graft. It is possible that in many cases a shorter period will suffice, but in general a rubber tube should be worn six months after skin grafting in the larynx, to keep the pressure on the graft and maintain the lumen.

DR LOUIS H CLERF, Philadelphia I want to compliment Dr Foster on his emphasis on conservatism and also patience in treating laryngeal stenosis. There is one organ that will not tolerate haste, and that is the larynx. Time is an important aid here, not only as a healer but in determining whether or not the result will be good.

I was interested in Dr Foster's reference to syphilis as a cause of the condition. It is interesting to note that the Continental literature attributes an important place to syphilis as an etiologic factor. I have never observed a case in which cicatricial stenosis of the larynx which required dilation or other forms of treatment was due to syphilis.

When thyrofixure plus dilation is needed, I am still adhering to the Schmiegelow method. I like it very much if there must be implantation of a rubber tube, and I have incorporated the skin graft method with it by putting my graft, a rather thick skin graft, around the tube, implanting the tube in the larynx and leaving it in for two or three months, according to the degree of stenosis and the amount of loss of cartilage.

DR CHARLES J IMPERATORI, New York. Last year I presented, or in a discussion spoke about, several cases in which the Jackson core molds were used, and yesterday I had the opportunity of presenting a patient here that took a year to get a dilatation from a degree at which a no. 16 core mold could be admitted to that at which a no. 38 core mold would enter. This boy had been injured by the use of radium and by two Schmiegelow operations. Complete stenosis of the larynx then developed and following the Jackson technic of making an artificial opening through the stenosis and then introducing the smaller core molds, I was able to get a dilatation. I wished to present him yesterday and possibly hold a sort of postmortem discussion on the subject today because it is a question in my mind in certain cases whether any operation eventually will prove successful. It all depends on the individual case, the individual patient and the physician or the laryngologist who is taking care of him.

A year or two years is a short time. If the cricoid ring has been destroyed or injured it may be necessary to bridge it with cartilage. It has been done successfully in order to do away with the tracheotomy tube. It may be possible that for the young man who was shown here yesterday it would be the only procedure.

There are 2 other cases that I can recall at this time, both of women who sustained fractures of the larynx, the cricoid being injured in both instances.

One of the patients moved from New York to Chicago and now is under the care of Dr Holinger. She could not tolerate the core molds. She prefers the trapdoor tracheotomy tube of Tucker and desires no further dilation.

I apologize to Dr Law for speaking about an entirely new way of viewing the larynx which he will present tomorrow, but if he will permit me I shall say that it seems to me that with this newer method, known as tomography, for which there are few apparatus in the United States at present, laryngologists would be in a much better position to prognosticate, with the assistance of lateral roentgenograms, exactly what type of treatment will give the best results and what will happen eventually to the patient. The method consists of taking roentgenograms at various planes, anteroposteriorly. The spinal column is not seen in the ray. The ventricles, the cords, the conus elasticus and the piriform sinus are clearly shown.

DR WALTER KIRCH, Des Moines, Iowa (by invitation). A patient in whom the cricoid cartilage was injured recovered, with a hoarse voice, after replacement of the cartilage.

DR JOHN H FOSTER, Houston, Texas. As to Dr Greene's reference to tuberculous patients, I have never treated stenosis in a tuberculous patient. I have always felt that it is better to leave a healed tuberculous lesion alone and let the patient breathe through a tracheotomy tube.

Dr New spoke of the length of time that the patient must wear a tube after having a skin graft. I think that depends to a great extent on the condition. In many cases in which there are bands of scar tissue and some distortion and one can dissect the skin and tissue out fairly well without much trauma and put a skin graft in and replace the cartilage, it is not necessary for the patient to wear a tube for any length of time. In cases of that sort, I take the precaution of having the

patient come back and passing the Jackson triangular dilators through the larynx in order to see that the pathway is kept open. I rather think that if one can do that the skin graft does better. There is not any question but that strong pressure for a great length of time on the skin graft will cause it to necrose and slough out. For that reason, I have tried to get my packing out as soon as possible and change it or put a tube back. After the skin graft has been placed the O'Dwyer tube is better than a rubber tube. I believe it causes less superficial necrosis of the skin graft. It is perfectly hard and smooth.

I have tried a gold tube, but it is too heavy. I think that the pressure of the tube is a disadvantage. That is one trouble with it.

Of course, such patients have to be treated individually. A great many of them simply will not tolerate pressure. Very little pressure will cause an intense reaction. One has to take the tube out.

There is one advantage, of course, of the external operation. One allows more give to the tissues, but if an ordinary straight tube slips up a little in a child it causes an intense reaction at the base of the epiglottis and around the arytenoids.

I am firmly convinced that when the cricoid cartilage has been cut, if its ends are dissected loose and by manipulation and use of sutures buried around them brought back into position when the operation is performed the time of healing will be shorter and the result better.

LARYNGOFISSURE FOR CANCER OF THE LARYNX DR CHEVALIER JACKSON, Philadelphia

It is generally admitted that failure to get good ultimate results from laryngofissure is due to operation on unsuitable patients. This raises a question of vital importance, namely, why is laryngofissure done on unsuitable patients? Some of the reasons follow.

- 1 Postponement of biopsy. It is amazing to note that almost all the literature treats biopsy as a last resort. It should be first and immediate in all cases in which malignant disease is a possibility.

- 2 Neglect of direct laryngoscopic procedure, not only to extract tissue for biopsy but as a means of examination.

- 3 Neglect of careful external palpation to detect evidence of internal perichondritis.

- 4 Dependence on exploratory operation for diagnosis.

- 5 The clipping technic. This should never be used except in cases in which the clip will be through healthy tissue 1 cm wide of the growth (the 1 cm rule). In all other cases the anterior commissure technic should be used. The greatest advance in the technic of the anterior commissure operation is the method of Chevalier L. Jackson for inspection of the interior of the larynx by means of a window opened through healthy tissue before excision.

HEADACHE DR HENRY A RILEY, New York

I shall discuss the neural components which are concerned in the appreciation of painful sensations and their transmission from the various structures of the head and the intracranial contents, the mechanism of the production of pain and the probable causes of headache.

DISCUSSION

DR ARTHUR W PROETZ, St Louis. I have been exceedingly interested in the subject of pain in the sinuses for a long time and have been completely baffled. The thing that disturbs me more than anything else is the apparent lack of any association between the appearance of the membrane and the symptom of pain.

Some time ago a patient was studied whose membrane was as nearly normal as any I have ever seen and who after an exposure to an allergen to which she was susceptible suffered a swelling of the membrane in the sinus to the extent of

about a centimeter, practically obliterating the sinus. The patient was not aware of this change, and it was found only through the routine examination to which she was subjected.

It is known also that frequently a patient's nose is examined and nothing is found to account for the pain and the next day it is examined again and nothing is found to account for the pain nor is there any pain. Pain seems to have no relation to any change in color or swelling or general condition of the sinuses on which reliance can be placed.

I should like to ask whether anything is known about the end organ mechanism of pain, in the sinus, for instance, not necessarily in the head—whether it is chemical, physical or a combination of both, whether it affects the nerve or the end organ or whether anything at all is known about the mechanism of the pain-producing organism in the sinus itself.

DR HARRIS P MOSHER, Boston. In what percentage of cases has Dr Riley found that the headaches are due to laryngologic conditions or the faults of laryngologists?

DR GORDON BERRY, Worcester, Mass. Does the differentiation between morning and afternoon pains and headaches have a causative factor?

DR HENRY A RILEY, New York. I am afraid the questioners are going to draw a blank on all their questions, because I do not think I can throw any light on any of the conditions mentioned.

In regard to the direct stimulation of end organs, most end organs are so situated that they can accept some sort of physiologic stimulation. That is, they are disposed principally in surfaces or in fascial planes, or, in the case of the blood vessels, the bulbs lie in the walls of the blood vessels or occasionally annular loops pass around the blood vessels. I think it is perfectly plain how the end organs are stimulated. They are stimulated by processes or factors coming into contact with surfaces or by things producing distention of blood vessels or contraction of blood vessels.

In regard to the sinuses, the end organs are all, as I understand them, free end organs in the mucous membrane, that is, close underneath the surface of the mucous membrane and the underlying supporting tissue. Now, whether their reactions are produced by intrasinal pressure or by toxic processes or direct irritation of contained material I do not know. I imagine that both processes may be active, under varying conditions.

I do not have an explanation for the situation cited of the apparent contradiction between the appearance of the mucous membrane and the patient's description of the subjective sensation.

Other types of pain, of course, can be produced by pressure on nerve fibers, nerve trunks or nerve roots, as I said before. That I do not think enters into the situation which was spoken of, because these pains are in the periphery, in the actual lining of the sinus itself. I imagine the cause is either a mechanical or a chemical process affecting an end organ which is capable of receiving that particular type of stimulus.

In regard to the percentage of cases, unfortunately I cannot answer that at all, because all the material met with in the clinic, in the hospital or in private practice is rather well sieved out before it comes to the specialists. Therefore, all the patients that are received have gone through the diagnostic process and in that process those with nasal conditions have been eliminated, then those with sinal conditions, then those with ocular conditions and so forth, so that most of the material that my colleagues and I get is neurologic, either organic or psychogenic. The only way, I imagine, that any such figure could be reached would be simply to go through a large general clinic, taking every case in which the symptom of headache was presented, tracing the condition to its ultimate origin, and finding out how many were neurologic and how many were rhinologic.

In regard to morning and afternoon headaches, I do not know. I know that the only thing that is at all comparable is the variability in patients with cerebro-

arteriosclerosis, with whom there is a material alteration in times of the day when they feel badly and when they have their headaches. Whether that would be applicable to the question asked I do not know.

CONGENITAL TRACHEOESOPHAGEAL FISTULA WITHOUT ATRESIA OF THE ESOPHAGUS. REPORT OF A CASE WITH PLASTIC CLOSURE AND CURF. DR. CHARLES J. IMPERATORI, New York.

This article was published in full in the September issue of the ARCHIVES, page 352.

DISCUSSION

DR. LOUIS H. CLERF, Philadelphia. Dr. Imperatori has done an excellent plastic operation. I think the subject of his dissertation should be congratulated because of his survival, when one recalls the large number of physicians with whom he made contact.

My connection with the case dates back to the fall of 1936, during October, when I was consulted because of the disturbance in swallowing. The roentgen studies made by Dr. Manges exhibited definite cardiospasm, some dilatation of the esophagus and intermittent opening at the left of the diaphragm, and the diagnosis was cardiospasm. I intended to corroborate the diagnosis, but I was unable to pass a 7 mm. esophagoscope through the hiatus into the stomach, as I should have done in a 5 year old child, whether he had simple cardiospasm or not. There was definite resistance at the level of the hiatus. I subsequently attempted the procedure with a no. 5 esophagoscope, and that, too, would not pass, but a no. 4 did pass into the stomach. So that, whereas the diagnosis was cardiospasm—or call it what one will—there were undoubtedly some periesophageal changes, whether it was fibrosis I do not know, of course. There was nothing within the esophageal lumen to suggest the cause.

At about that time my connection with the case terminated, as the young man was able to swallow somewhat better. The question arising in my mind is whether the lesion is congenital. As Dr. Imperatori has indicated, the common site of fistula is at practically the bifurcation of the trachea, at times a tiny bit above and at times a tiny bit below. I never heard of a case in which the fistula was at this high level, and I am curious whether any one can give any additional light on whether the fistula actually is congenital, probably Dr. Imperatori can give some additional light, although he indicated in his title that he regards it as congenital.

DR. CHEVALIER L. JACKSON, Philadelphia. The things I should like to say are similar to those already said by Dr. Clerf.

I should like to say a word also about my endoscopic experiences in the case. Like Dr. Clerf, I first did an esophagoscopy examination, and attention was from the beginning called to the esophagus. I did not see a fistula, and my impression was that there was stenosis, so-called cardiospasm, at the lower end of the esophagus, and perhaps the reason that my associates and I did the tracheoscopy and hit on the diagnosis was that at that stage of the condition the broncho-pulmonary aspect was much more in evidence than earlier. At this time a cough and the findings on physical and roentgen examination of the chest had developed as the most conspicuous symptom. Therefore, we did the tracheal examination, and the experience was worth mentioning. The endoscope, on being passed through, of course, was found to enter the esophagus almost at once. It slipped in easily. Dr. Sippel and Dr. Cunning were both present at the time, and they will recall that I thought that perhaps it had slipped off to the side of the azygos and into the esophagus. But in order to make sure, I withdrew it and introduced it again, exposing the larynx plainly to the view of all, and then passed it in slowly through the cords. I could definitely see the fistula. I could see the lower border of the fistula, which was constituted by the party wall between the trachea and esophagus. We felt the diagnosis was definite and then proceeded

with special roentgen studies and succeeded in visualizing the fistula in films I advised that the fistula be closed I felt that it was possible to close it, but I was most delighted to find that it was so successfully accomplished by Dr Imperatori

DR GEORGE B WOOD, Philadelphia Dr Imperatori, the child was given barium sulfate to swallow, was he not? Why did that not go through the fistula into the trachea?

DR FLETCHER D WOODWARD, Charlottesville, Va This is probably the first case in which a condition of this kind has ever been successfully treated

In regard to the diagnosis, Dr Imperatori showed a unique slide in which a bougie had been passed through the trachea into the esophagus, and having some slides here for another purpose and recalling a case in which that method was used in diagnosis, I am showing the accompanying slide However, it happens to illustrate a case of carcinoma in which a tracheoesophageal fistula was present with the opening at the level of the bifurcation But in order to work out the details of the condition, my associates and I passed a radiopaque ureteral bougie through the fistula and down to the esophagus, which gave considerable extra information as to the location and the nature of the fistula

DR MERVIN C MYERSON, New York About twelve or thirteen years ago, Dr Porter P Vinson, then of the Mayo Clinic, advocated as a test for tracheoesophageal fistula the passage of a string, or the swallowing of a string, rather, and said that invariably in the presence of a tracheoesophageal fistula the string would go down to the side of the fistula on the esophageal side and wind itself around the party wall I have seen that twice with tracheoesophageal fistula due to carcinoma

DR CHARLES J IMPERATORI, New York Dr Sippel has told me that the child had had three different gastrointestinal series of roentgenograms previous to the closure of the fistula

I do not question the diagnosis of cardiospasm The child had pylorospasm and there was no reason why he could not have had cardiospasm The pylorospasm was operated on, and for the time being he seemed to be a little better The manipulation of the operation did something that permitted him to swallow a little better I feel that his symptoms of cardiospasm are very definite

Professor Terracol, in his fine book on the esophagus, definitely pointed out in an illustration that there is such a type of fistula, and included a drawing of it

Regarding the tracheoscopic examination done by Dr Jackson, I feel that that was the turning point in the child's life At a meeting of the New York Laryngological Society I was asked several questions, such as why the string appeared in this child's trachea I felt that the reason was that the string had been regurgitated from his esophagus, that is, that because of the anchoring of it in the lower intestinal tract the loops of the string had regurgitated from his esophagus into his trachea, through his larynx But the possibility of a fistula did not occur to me, and I did not agree with Dr McCullagh in offering that explanation Of course, I agree with him entirely now

Regarding Dr Wood's question, the child had symptoms of regurgitation from birth and many attacks of bronchopneumonia His lung seems to be clouded, so that one might think that he had acute pneumonia I feel that my theory of a valvelike arrangement is the explanation of his fistula and that the string going through the fistula and being pulled on both from below by the peristaltic action of the whole intestinal tract and from above by the bronchoscopic procedures or at least by Dr Cuning, who found the string, and the looping of the string in the trachea may have in some way disturbed this sphincteric action so that it was more easily seen But the whole area was definitely epithelized The fistula was not an artefact It was not a puncture wound There was definite epithelization from the trachea into the esophagus

I saw the fistula I also had the good fortune to have standing by at the time of the operations Dr Buckley and Dr Cuning They both saw the fistula,

and we could not see the esophagus because of this trapdoor-like arrangement on the esophageal side. I think that explains, Dr. Wood, why the barium sulfate which he had made various attempts at swallowing previously never appeared in his trachea.

I did not know of Dr. Vinson's experiment with the swallowing of string to demonstrate a fistula in the esophagus. It succeeded, of course, because the fistulas were carcinomatous and lower in the region of the jugulum. I feel that the further treatment in the present case should be hydrostatic dilation, and I hope eventually that one can speak of cure, both from the standpoint of the respiratory tract and also from the standpoint of the esophageal tract.

TONSILLECTOMY LOCAL RESULTS AND INFLUENCE OF THE OPERATION ON SURROUNDING TISSUES DR. EDWARD H. CAMPBELL, Philadelphia

This article will be published in full with discussion in a later issue of the ARCHIVES

CONSIDERATIONS OF TUBERCULOSIS OF THE LARYNX DR. MERVIN C. MYERSON, New York

A large series of cases of tuberculosis of the larynx has been studied. As a result statistical data have been gathered concerning various phases of the disease. If this study shows nothing else, it demonstrates the lack of value of most local therapeutic measures which have been advocated for tuberculosis.

DISCUSSION

DR. JOSEPH B. GREENE, Asheville, N. C. I have been interested in this subject for a number of years. The chairman of this meeting started me twenty years ago in this line of work, and I still have his three types of cautery point, the puncture, the loop and what he calls the knife, the searing instrument. That shows how much I believe in the cautery.

I thoroughly agree with all that Dr. Myerson said, that certain conditions are unsuited for the cautery. I have in mind the conditions to which he refers, the acute edematous type. In reference to the use of the cautery, it seems to me that there are certain indications and contraindications, and one of the indications I have in mind is the sedimentation rate. If a patient has a poor sedimentation rate, that is, if his sedimentation is rapid, in my opinion, the condition is too acute to justify the use of the cautery in that case. However, the use of the cautery is still justified for relief of pain, but the painful conditions are usually unfavorable.

Since the use of the three types of compression therapy, pneumothorax, thoracoplasty and resection of the phrenic nerve, the incidence of tuberculosis of the larynx has diminished very much indeed.

I agree with Dr. Myerson in so many respects that I regret to disagree in one respect, that is, on the mode of infection. I can hardly think of this disease as being an infection of the blood stream and lymphatics in its origin. I shall mention several reasons. First, Dr. Myerson emphasized the fact that infection usually occurs in the posterior aspect of the larynx, and that has been my experience. That indicates that the deposit of the sputum in the posterior surface of the larynx affords a favorable site for entrance of the organism.

Then again, if it were a blood stream infection, why is it that children who have tuberculosis, who usually have no organisms in the sputum, have no infection of the larynx? They acquire meningitis, which is due to a blood stream infection, and yet they do not have any infection of the larynx.

Several reasons might be offered why I am strongly of the opinion that the disease is transmitted by contact rather than by the blood stream and the lymphatics.

DR. FREDERICK T. HILL, Waterville, Maine. I, too, have been much interested in the decreasing incidence of laryngeal tuberculosis seen in the past few years with the advent of pneumothorax, phrenicectomy and thoracic surgery. Following such cases for about nineteen years in a fairly large state institution, my colleagues and I are rarely called on even to use the cautery.

DR. BURT R. SHURLY, Detroit. Throughout forty-four years, it has been my privilege to direct part of the work in several sanatoriums in Detroit. It is known that while the death rate of tuberculosis stood first on the list many years ago, it is now down to fifth place in Michigan.

In the institutions with which I am associated, my colleagues and I find from 15 to 18 per cent of patients with some involvement of the larynx. I feel that the condition is not always a blood stream infection. It seems to me that the view that it originates by contact infection is plausible and correct in many cases. Tuberculosis is now a surgical disease, a great change from the older days, when climate seemed to be the objective, with no specific and no special treatment. People have been educated now to go into a sanatorium, where all the patients with laryngeal tuberculosis belong, it seems to me, and a state law in Michigan requires that they be hospitalized.

I have never seen primary involvement of the larynx that I can remember. I should like to ask Dr. Myerson if he has seen a case of primary involvement.

The real solution of the problem is the tuberculin testing and roentgen examination of the children of the nation and the early diagnosis, when the condition is perfectly curable and when it does not involve the larynx among these children. I look to the final solution in a nationwide spread of more efficient, early diagnosis of tuberculosis, which is coming rapidly in my part of the country.

DR. RALPH A. FENTON, Portland, Ore. May I be permitted to make a suggestion respecting lymphatic drainage of the laryngeal region? Perhaps it is in the nature of a correction. Dr. Larsell, who was associated with me in some experimental work on the drainage of the sinuses some years ago, brought out that the drainage from the larynx is downward and lateral, into the laryngeal glands and then on down toward the mediastinum, but that the material drained from these glands falls directly into the pulmonary circulation, drops in on both sides and is pumped directly out to the periphery of each lung.

Now it is understandable that in the course of laryngeal tuberculosis, as I think those with experience will agree, occasionally the patients seem to decline with extreme rapidity with an acute military spread. It is understandable that the infection may go in through the thoracic duct and thus into the circulation from drainage of the laryngeal glands, but that is downward instead of upward. I should be inclined to agree with Dr. Shurly and others that the liability of implantation by direct contact is more probable.

DR. GORDON B. NEW, Rochester, Minn. I should like to ask Dr. Myerson whether in the group, of 8 patients, I think, that died without having organisms in their sputum the diagnosis was questionable. I take it a check was made post mortem to show tuberculosis. In a group seen at the Mayo Clinic the question of blastomycosis and torulosis came up when the condition was clinically tuberculosis but the sputum did not contain the organisms. I am wondering whether in the huge group of 2,000 cases the question of blastomycosis and torulosis was considered.

DR. FLETCHER D. WOODWARD, Charlottesville, Va. A survey of patients admitted to one of the state hospitals during five years, from 1923 to 1928, against a similar group admitted from 1933 to 1938, showing the results of modern treatment, is of interest. My associates and I feel that the addition of collapse therapy has been the one thing which has done the most to lower the incidence of laryngeal tuberculosis, because the organisms disappear from the sputum earlier. Therefore, that is the answer to the complication of laryngeal tuberculosis. The sooner the

organisms can be eliminated from the sputum, the less chance there is of the development of laryngeal tuberculosis

In the first group, of 1,090 patients, admitted during five years 12.5 per cent had tuberculosis of the larynx on admission, in a similar group, of 1,139 patients, admitted during the past five years 13.3 per cent had tuberculosis of the larynx on admission. That looks as if perhaps the incidence is not lower, but I think that it is, because many patients are now admitted to the sanatorium that in the first five years would have been sent home to die. We treated only early tuberculosis years ago, whereas now we take any patient that presents himself at the sanatorium. So the percentage of laryngeal tuberculosis there is about the same as it was ten years ago.

Of these patients, 95.6 per cent in the first group and 90.1 per cent in the second group had tubercle bacilli in the sputum on residence in the sanatorium. On dismissal from the sanatorium, 63.2 per cent of the first group still had the organisms in the sputum, whereas in the second group the incidence was diminished to 50.2 per cent. So that we have 13.2 per cent in our favor, which I believe, considering that the more severe, more advanced conditions are treated, is largely because collapse therapy has been added to our treatment.

Of the 136 patients with laryngeal tuberculosis in the first group, 14 per cent received cauterization of the larynx, of the 152 in the second group, 19 per cent, approximately the same. But in the first group only 4.4 per cent, 6 patients, received collapse therapy with artificial pneumothorax only, whereas in the second group, 49.3 per cent, 75 patients, received collapse therapy of various types. At discharge from the sanatorium, 44.1 per cent in the first group were improved, whereas 52.6 per cent in the second group were classified as improved and this group, of course, as I said before, included patients with much more severe tuberculosis than were present in the first group.

We feel that collapse therapy is an important factor in the cure and prevention of laryngeal tuberculosis.

DR GEORGE B. WOOD, Philadelphia. Perhaps I am somewhat like Dr. Greene. I cannot quite agree with everything that Dr. Myerson has said. In the first place, I am convinced that the method of infection is never lymphatic, that the primary infection is never brought to the larynx from lymphatics that are outside of it but that it may be brought by the blood stream. Just how often that occurs, I am not certain. It apparently occurs in some cases exactly as does tuberculosis of the hip. To my mind, that is the exception, and the large majority of infections are from contact with sputum that comes from the lungs.

In the first place, in practically every case laryngeal tuberculosis has been preceded by pulmonary tuberculosis. In the second place, the lesions are superficial in their early stage and immediately beneath the epithelium and not in the deep layers of the mucosa.

The occasional development of laryngeal tuberculosis with a negative reaction of the sputum does not preclude the possibility that the larynxes may have been infected by sputum that some time earlier in the patient's life contained tubercle bacilli. According to Manasses, the infection may gain access to the subepithelial layer either as a result of minute trauma or, as Lake has pointed out, through minute intraepithelial pyogenic abscesses that are frequently seen in chronically affected larynxes, on the other hand, they have been demonstrated passing through normal epithelium. They have certainly passed through the normal epithelium of the intestinal tract and through that of the tonsil.

I am absolutely convinced that no local therapy is of any value in the treatment of laryngeal tuberculosis as compared with the application of the actual cautery. The only patients for whom I refuse to use it are those with a hopeless condition in whom the least trauma, the least excitement or the least discomfort adds to the general pain and unhappiness. I have never encountered a case of tuberculosis, either acute or chronic, in which I thought the cautery was contra-indicated, except by the general debility of the patient.

DR MERVIN C MIERSON, New York. I was very much aware when I said that the larynx was invaded by way of the blood stream that I should stir up some real discussion. Perhaps more has been learned because of that discussion. I appreciate the assistance that I have received from the various discussions in making this presentation more valuable. I agree with Dr Greene about the use of the cautery for painful conditions, and I think that it should not be withheld for any type of ulceration but should be used for searing the surfaces of the ulceration, because frequently one reaches the sensory nerve endings and relieves the patient, at least temporarily, of his pain.

There are undoubtedly some cases in which the condition is due to contact, but there are many cases in which one cannot disregard the hematogenous method of spread to the larynx. The pediatricians and pulmonary specialists state that children have an entirely different type of tuberculosis from adults. In them the lymph nodes are infected. When this lymphatic type reaches a terminal stage, it is not unusual for a child's larynx to become involved by way of the blood stream. Fortunately, because they have this type rather than a true pulmonary type, involvement of the larynx is not seen as it is in adults.

I should like to call attention also to the fact that almost 60 to 70 per cent of the lesions which have been observed on the tongue are located in areas of the tongue which would not ordinarily make contact with the sputum. In other words, they are not on the dorsum but on the under surface in the region of the frenum and anterior to it.

I should go further than Dr Wood and claim that the sputums not containing tubercle bacilli are evidence of a hematogenous condition, and in addition to claiming this I call attention to the fact that it is not at all uncommon to see patients with no organisms in the sputum who have the laryngeal condition.

Now as to primary involvement, I think primary involvement can be dismissed with this one statement, that up to the present time (perhaps tomography will change the concept) diagnostic procedures have not been adequate to enable one to say positively that a patient does or does not have tuberculosis of the lung when he has a lesion of his larynx. In other words, he may have a lesion in his lung which is not shown on the ordinary roentgenogram.

The concept of the spread of tuberculosis from a pulmonary lesion is that it goes by way of the lymphatics into the blood stream. Occasionally it passes from a local focus directly into a capillary or blood vessel, but usually it goes into the major lymphatics, and then into the thoracic duct and then spills into the blood stream.

I do not know anything about the 8 patients who died without tubercle bacilli in their sputum. I do know that between 80 and 90 per cent of the patients who die are submitted to autopsy and there were none among this group with blastomycosis or torulosis.

I agree with Dr Woodward about the value of collapse therapy, but one must not make any blanket statements as to its value in all cases. In other words, patients are encountered who have had the benefit of collapse therapy and who do not improve. They frequently have a tracheal or bronchial lesion.

In answer to Dr Wood, I am well acquainted with Manasses' work, but I should like to call attention to the fact, first, that anybody who has tried to examine the lymphatic vessels histologically will state that it is almost impossible to outline them by any method, and, second, that I reviewed over 900 slides in this study and I took many of them in the beginning of the study. I thought that I saw the thrombolympangitis which Manasses described, and I tried to get three or four pathologists to corroborate my finding, and they would not. They said that they never find thrombolympangitis anywhere in other organs, that they have not seen it in the larynx and that they could not find it in my slides. My associates and I did special stains on about 30 slides, and we could not depend on our findings there. So I do not know whether Manasses' findings are correct. They may be all right, and we may not know how to look at the lymphatics.

PLASTIC REPAIR OF THE FRONTAL BONE DR GORDON B NEW, Rochester, Minn

Acquired defects of the frontal bone are usually secondary to radical operations on the sinuses, intracranial operations, automobile accidents and cured malignant disease. They require correction for cosmetic reasons and to alleviate the symptoms complained of by patients with absence of the full thickness of the skull. Costal cartilage has been found to be the material of choice for correction of bony defects of the frontal bone. Five cases are reported. A colored motion picture will be shown.

DISCUSSION

DR SAMUEL SALINGER, Chicago I am exceedingly interested because of several experiences that I have had along similar lines. Two or 3 minor post-traumatic depressions that I have encountered were easily corrected. One patient, both of whose frontal sinuses had been completely obliterated, caused considerable difficulty. This patient had also had an abscess of the frontal lobe which necessitated two or three operations. He eventually recovered but had a hideous deformity which extended over the entire supraorbital region from one external angular process to the other.

One large rib graft was placed within the depression, and quite by accident, I believe, I left a little of the perichondrium on, which gave it the necessary contour, that is, the necessary convexity. I should like to ask Dr New whether he makes it a point to strip the perichondrium entirely or whether he ever uses the perichondrium for the purpose of obtaining a convexity.

DR THOMAS E CARMODY, Denver I should like to emphasize what Dr New says, that nothing should be done for the traumatic conditions for a little time. When bone and cartilage are used I find the contour remains rather good, but if the cartilage is used alone, frequently it is absorbed. I should like to ask Dr New about that. As a rule, I strip the periosteum off, but there is a possibility that in some cases it should be left.

DR HARRIS P MOSHER, Boston My associates and I have been responsible, in part, for creating more hideous deformities of the forehead than any shown by Dr New. In other words, in dealing with fulminating osteomyelitis of the frontal bone as we see it, we have settled down to rather a routine operation, which calls for the removal of the whole of the frontal bone. That leaves a marked deformity.

We have found in dealing with cartilage the same trouble that Dr Carmody spoke of, that it is absorbed. Dr Kazanjian, in dealing with these deformities, makes a two stage operation, the first step being to get the skin flaps together. We use a median incision, so that we can see all around and work easily through the off corners of the frontal bone. The first job is to get the flaps together, after waiting at least three months. Then comes the attempt at repair of the deformity. Dr Kazanjian has settled down to using a tibial graft. The graft when one sees it first is a bit surprising. I do not believe that it would surprise Dr New by the extensiveness of the procedure, but it astonished my associates and me at first. He takes a graft according to the defect, from the tibia, makes it pliable by saw cuts, puts it in, takes another one if there is anything left of the shin, puts that above the first one, then gets his measure of correction and after that fills in with cartilage. That is the procedure which is being used now, and it is fairly satisfactory.

I do not believe that any of the extensive deformities will ever be perfectly removed. I was interested in the use of the pattern, that also is a great help.

DR MERVIN C MYERSON, New York I should like to ask Dr New to what extent the defect is overcome by the production of osteoid tissue. I am not speaking of the tremendous defects, but I am thinking of the patients who have had resection of the frontal sinus and some of the adjacent bone because of osteomyelitis that is complicating disease of the frontal sinus. I might say that at the hospital with which I am associated the neurosurgeons have been collecting sections of the skull, and my colleagues and I thought that we could use them as

replacements for defects, but it seems to me that they are more or less valueless, because they invariably become infected and we have to remove them

DR CHARLES J IMPERATORI, New York Dr New has presented excellent photographs with wonderful depth of focus

There is a guest here today, Dr Carter, who is one of the pioneers in the work of transplanting cartilage

DR WILLIAM WESLEY CARTER, New York (by invitation) Dr New's exhibition of his work is the best I have ever seen

I have had some experience in transplanting bone and cartilage, and a number of years ago I began to use conjoined bone and cartilage in the correction of nasal deformities, to which my experience has been largely confined I have corrected a few cranial defects, but that has been a minor portion of my work Two of the corrections of cranial defects with which I felt more gratified than with any others were accomplished by the use of tiny splints of bone They were removed from the rib and were largely composed of the cancellous tissue near the junction of the cartilage and bone I found after six or eight months that a considerable osteogenesis had occurred and that the defects, which were small in the cases in which I operated, had become osseous, and this led me to believe that in many cases an osseous deformity can be corrected by the use of finely chipped pieces of bone containing considerable cancellous tissue which is rich in osteoblasts

The use of cartilage is preferable in many cases to the use of bone, because it is far more easily handled I have used portions of the seventh, eighth and ninth ribs

In reference to the preservation of the perichondrium, I will say that I never preserve it, because I have found that when I did so in my corrections of nasal deformities, toward the tip, where I wished to preserve flexibility, the perichondrium had a tendency to curl the cartilage up

I have not had any trouble from the absorption of cartilage unless there is an accidental infection at the time of the operation If there is, the cartilage is absorbed, and in many instances the bone has to be removed But in a number of instances I have been able by antiseptic methods to control the infection, and the portion of the bone that remained had a dendritic look, as if the portions that had died from the infection had been absorbed and the rest of the transplant had remained

DR E ROSS FAULKNER, New York I wish to ask Dr New a question How much regeneration of bone occurs after osteomyelitis?

An infant, 9 months of age, was operated on for osteomyelitis of the frontal bone, and the whole bone was removed After three years, complete regeneration has taken place

I wonder if Dr New has had an experience like that I think the child would have been better if it had not made such complete regeneration of the bone

In regard to reconstruction after operation on the frontal sinus, I think I have a few derelicts I shall send to Dr New I have always regarded the staphylococci as sleeping dogs It is just as well to let them lie in a great many cases I always feel a little apprehensive about operating in such cases until a long period after the original infection

I think there is no question that the rib cartilage is by far the best material to use for overcoming the defects, but I hesitate to operate until I am pretty sure that the infection has ceased

DR GORDON B NEW, Rochester, Minn On the question of preserving the perichondrium, it has been brought out by some of the discussion that in getting certain contours, building an island and procedures of that kind, if one saves the perichondrium one will get a curve For that reason my associates and I take it off in most of our cases in which we use cartilage

On the question of absorption of the cartilage, in the cases I have presented four years two years and one year have elapsed since I put the cartilage in, and

I have not seen any absorption. It has been my experience in general that it has not been absorbed.

Of course, I am well acquainted with Dr. Kazanjian's work, to which Dr. Mosher referred. I talked with him about the method of handling the cases. He does the work, of course, as Dr. Mosher has brought out. He uses the periosteum graft, building it up in stages and then using the cartilage to finish and to fill in the defects. I should think that in cases such as Dr. Mosher has outlined this method is certainly the treatment of choice.

In infants, such as Dr. Faulkner referred to, there is a great deal of regeneration, while in adults I have not seen that occur.

I was delighted to have Dr. Carter discuss this work, because I remember visiting him twenty years ago and seeing the wonderful work he did.

FURTHER EXPERIMENTS IN THE ACTION OF DRUGS ON THE NASAL MUCOSA DR ARTHUR PROETZ, St. Louis

This article was published in full in the October issue of the ARCHIVES, page 509.

DISCUSSION

DR THOMAS E. CARMODY, Denver. I should like to ask Dr. Proetz if when ether or chloroform is dropped on the membrane it will be restored after a little or the disintegration is so great that there will be an ulceration.

DR THOMAS C. GALLOWAY, Evanston, Ill. I should like to ask Dr. Proetz if he has done any work on carbon dioxide in relation to his study of anesthetics. Waters has recently reported work which indicates that carbon dioxide might be irritating to the mucosa of the respiratory tract.

DR ARTHUR PROETZ, St. Louis. I have had no experience, Dr. Galloway, with carbon dioxide. While the experiment with nitrogen monoxide was going on my associates and I frequently found that we had to warm the gas as it came through, because the chilling of the gas in the valve of the tank made the air so cold that it stopped the cilia. As soon as that was dispensed with, the cilia were not affected.

As for the destruction when the anesthetic touched the membrane, the disability lasted as long as we could keep up an experiment with one animal in the course of several hours in the day. From the appearance of the membrane and from the general disintegration, I think that a resuscitation of the surface would be impossible. I should think that the process would have to be one of regeneration.

SINUSITIS: THE PRESENT RATIONALE OF TREATMENT. DR CHARLES T. PORTER, Boston

In the treatment of acute sinusal disease, rhinologists are in danger of becoming too stereotyped. Some writers say that one should never operate, while others are inclined always to advise operative treatment. The best results are obtained by evaluating each case and using the procedure which seems best under the existing circumstances. Cases of chronic sinusitis can be divided into three main groups. Conservative treatment is applicable to certain types of subacute condition. Allergic conditions require careful investigation in order to determine the most effective treatment. Chemotherapy has become more valuable against all acute conditions. The antagonistic attitude of the general practitioner and the public to any operative procedure for sinusal disease is becoming a serious problem to the rhinologist.

DISCUSSION

DR RALPH A. FENTON, Portland, Ore. The tendency to abandon overtreatment, such as the use of strong antiseptic drops, is largely due to the work which has been done by Dr. Proetz and Dr. Lierle. But still rhinologists often ignore allergy, as allergists often ignore the work which rhinologists are doing.

One must agree that operation, if it is done at all, must be complete, whether it is for the ordinary condition or for the condition with an allergic complication.

That principle, I think, should be basic. I feel that in practice in the West in general the rule is to avoid operation in the acute stage of severe and fulminating infections. At the present time reliance has come to be placed on the use of sulfanilamide rather early.

With local drainage and the infraction of a middle turbinate perhaps, it has been found that sulfanilamide kept at a constant concentration by daily and nightly use and given not in excessive doses but rather in steady, moderate doses, according to the principles brought out in the excellent studies of Osgood, works out best. But in any case in which sulfanilamide is used check must be made by daily leukocyte and erythrocyte counts, because one will find undesirable complications from that if one does not observe closely the reaction of the individual patient.

Respecting diathermy, it may be recalled that Dr. Larsell and I checked up on the tissues of a number of patients whom we caused to be treated by diathermy in the presence of chronic sinusal disease in the antrums, and all that we found it did was to attract red blood cells and cause a highly hemorrhagic membrane, which was much harder to operate on when we brought the patients to operation.

However, a few persons, having had the use of diathermy, refused operation because they felt better. Perhaps that was psychologic. I do not know.

Respecting the matter of roentgen treatment, that originated with Drs. Butler and Woolley in Portland, Ore., who are excellent roentgenologists, but became obsessed with the notion that small doses of carefully filtered roentgen rays are highly beneficial for all types of sinusal disease.

Dr. Woolley cooperated with Dr. Larsell and me by asking us to study the results of experimental irradiation of a number of cats in which we had produced artificial sinusitis, according to the method which we laid down in our research some years ago. After the sinusitis had been in existence from a week to six weeks or two months, irradiation was done, then we recovered the membranes. The conclusion was that all that the roentgenization does is to kill round cells. Apparently the release of the alexins, the immune bodies contained in these cells, was responsible for the good condition in which certain of the membranes were found, there was no effect on the influx of white cells, and there was no effect on the destruction of pus. It was not destroyed, and that was brought out by certain prominent radiologists who joined in the discussion at Cleveland. So this treatment is apparently dangerous and is likely to be taken up by quacks, as I pointed out in my discussion five years ago at Cleveland.

DR. SAMUEL McCULLAGH, New York. Dr. Wood, I should like to ask Dr. Coates and his confreres from Philadelphia, who have been using caminol, to make a little further report on the use of that drug or combination of drugs in the treatment of sinusal disease. I have used it myself since they recommended it to me, with beneficial results.

DR. WILLIAM WESLEY CARTER, New York (by invitation). I should like to ask Dr. Porter if he has found that bronchiectasis is frequently associated with chronic sinusitis, if he has ever used sulfanilamide in the treatment of it and what his results are. I realize that this question is not quite germane to the subject, but it is an important corollary.

DR. GEORGE M. COATES, Philadelphia. I am in accord with most of the things which Dr. Porter has said, although not quite with all of them.

I was particularly interested in his reference to roentgen irradiation, because a wave is sweeping over the country of having sinusitis treated by roentgen rays, largely promoted by the roentgenologists themselves.

I know that the best roentgenologists in Philadelphia think that roentgen irradiation of sinusal infections is effective, and they base the opinion not only on Dr. Woolley's work but on their personal experiences. I can think probably of three or four leading roentgenologists in Philadelphia who assert that they have cured themselves after having run the gamut of regular rhinologic treatment, including operation, which of course makes them, feeling as they do, think that this is an effective method of treatment. When, however, I have referred my

patients to these same roentgenologists, the results have not been satisfactory to me or to my patients as a rule. I do not know whether the treatment has any beneficial effect but I do not think that it should have, certainly not for chronic conditions.

I disagree with Dr. Porter a little about the efficacy and the danger of needle puncturing the antrum for washing out chronically infected maxillary sinuses. I think all will agree, of course, that the introduction of the needle into a sinus filled with hyperplastic tissue is not only dangerous but absolutely without benefit. When hyperplastic membrane is not present or not very much hyperplastic membrane is present and the sinus has a definitely purulent secretion, I am quite convinced the old plan of washing out, for a trial period, at any rate, often does quiet the infection and give the mucous membrane of the antrum a chance to recover a little, so that even if a radical operation is necessary later, the mucous membrane is in better condition for it.

An obliterative operation on the sinus, of course, aside from the deformity it causes, is the ideal termination of chronic sinusal infection. It is not feasible for infection of the maxillary, ethmoid or sphenoid sinuses.

I cannot agree with Dr. Porter in his statement that it is most useful in the case of large frontal sinuses. It seems to me that the obliterative operation is particularly applicable when the frontal sinus is relatively small and particularly when it is shallow, when the sinking in of soft tissue gives rapid obliteration.

I agree entirely with him that if an obliterative operation is attempted it must be absolutely complete, that the least shred of mucous membrane, which is always infected, of course, that is left will surely lead to failure of that type of operation.

I observe a good many cases of osteomyelitis, but I have not personally seen osteomyelitis develop after a radical operation on the frontal sinus except in 1 instance in which the Lynch operation was done, the floor of the frontal sinus being removed for the purpose of avoiding the possibility of osteomyelitis.

I entirely agree with Dr. Porter that when the anterior plate of the frontal sinus is necrosed it is a temptation to take that away and let the rest of it go. I think it can be done if the necrosis is limited to the frontal plate. When it extends to the junction of the internal plate and the external plate I always fear the development of osteomyelitis. When it is found at operation that this has already occurred, I think it is wise to go ahead and be radical and remove the bone with a considerable margin, as advocated by Dr. Mosher.

I dislike to talk about camiol, because, after all, it is a proprietary preparation. It is a combination, in a vegetable oil base, of camphor, iodoform and other forms of iodides, all of which have been recommended at various times in the books on pharmacology. I think that its use is of value as an adjunct treatment, that it does not replace, in most instances, the ordinary methods of treatment of either acute or chronic sinusal infection and that it is of value especially for acute conditions and acute flare-ups, such as Dr. McCullagh has experienced.

DR. FREDERICK M. LAW, New York. I do not know whether I am here to defend the rhinologist or the roentgenologist. Personally, I am not in favor of roentgen treatment of the sinuses. The treatment started in this way. In the old days, when plates were used, exposure was necessarily long, and every roentgenologist observed the fact that many times a patient with an acute condition of the frontal sinus had pain relieved after an interval of about a half-hour—relieved temporarily, it is true, but relieved.

Personally, I do not undertake therapy, therefore, what I have to say is only on observation and hearsay. I suppose I have not any right really to criticize. Now, roentgenologists display films showing involvement of the antrum before and after treatment. Perhaps, as often happens, the first films were made by one roentgenologist, the second films by another. I will show at the end of my paper two films made of the same patient at the same time, one showing a diseased antrum and one a normal antrum.

So, the chances are that a great many of the reports of clearing of the antrum are due to the technic in the making of the film. I have talked with many roentgenologists. The majority are not in favor of this treatment, the minority are.

DR WILLIAM B CHAMBERLIN, Cleveland. I am not sure that I am quoting Dr Porter correctly. I understood him to say that with acute conditions puncture of the antrum is dangerous and that with subacute and chronic conditions it is unnecessary. Is that correct, Dr Porter?

DR CHARLES T PORTER, Boston. Not exactly. I said that with acute conditions it is dangerous and that it is efficacious for subacute but not for chronic conditions.

DR WILLIAM B CHAMBERLIN, Cleveland. First of all, in regard to acute conditions, I have heard, of course, the dictum of Furstenberg and Lillie, pupils of Canfield. Now I do not know personally from my own experience how these conditions can be treated by the methods that Canfield and his pupils advocate. It seems to me that with an acute condition of the antrum, for instance, needle puncture is going to relieve the patient. In the thousands of cases that I have observed, not only in my clinic but in the experience of my confreres, I have yet to observe the first case of osteomyelitis from antral puncture. I should like to get the expression of the other members of the association.

Osteomyelitis from operations on the frontal sinus and external operations on the ethmoid sinuses is something entirely different.

I appreciate very much what Dr Porter said about the relation between the rhinologist and the allergist. Many patients are treated by allergists alone. Personally, from my own experience, and that of my confreres, I have about lost faith in allergy.

DR BURT R SHURLY, Detroit. The members of the association are certainly indebted to Dr Porter for bringing up a subject that is an everyday one for the rhinologists and that is met with daily in the office and in the hospital.

I feel that the problem of sinusal disease can never be anything but a problem of the individual patient. I believe that when the patient comes into the office seeking comfort and relief, one's duty is to give him all of that in continuous attention to the various phenomena that one has to deal with in that particular person.

Now major operations, it is well known, are essential and absolutely necessary, but it is a comparatively small number of patients with diseased sinuses that require a major operation. There are 90 or 95 per cent of other sufferers who come to the rhinologist. And is it forgotten that the patient has a definite immunity of his own? He is confronted with a special virulence of the infection which is attacking him at a particular time, and he is also an individual, temperamental or otherwise. I have taken care of a number of members of the theatrical profession, who are entities. With such a person the nervous system is entirely an emotional discharge, and a sinusal infection to him means a loss of his job, or it means a serious matter.

Then, again, there are persons who are entirely influenced nowadays by their next door neighbors or the bridge partners they had in the afternoon and whose treatment of the condition is just like their friends'.

I find sulfanilamide of tremendous importance, and I think it should be used more and more but its use should be carefully guarded. One should ascertain that the patient does not have Bright's disease or a serious dyscrasia of the blood and check one's use of it accordingly.

Then, again, I believe with Dr Chamberlin there are acute infections with which the sinuses can be washed out with great relief and that a general rule cannot be made for all cases and all people.

DR JAMES A BABBITT, Philadelphia. I have felt many times that a careful and complete irradiation of the sinuses acts therapeutically.

In selected cases, caminol has helped some of my patients.

DR CHARLES T PORTER, Boston First, I shall briefly try to answer Dr Fenton on the use of sulfanilamide I tried to convey that I do not use it for early or for uncomplicated conditions For conditions that show an immediate complication, like cellulitis, my associates and I institute its use at once if we have the proper culture But for uncomplicated sinusal disease, I do not believe it is necessary, and Dr Lyons, whose work I follow, maintains that it is much better to let the patient develop his own antibodies, if he will

Dr McCullagh has been answered about camicol, and I know nothing about it

Dr Carter, my associates and I do not have patients with bronchiectasis ourselves in our wards They are in the thoracic or the pulmonary clinic of the Massachusetts General Hospital I believe that the physicians in those clinics have had indifferent success in some of the cases in which they have tried sulfanilamide That could be understood from our bacteriologic findings, and in bronchoscopic examination of the patients we frequently find a variety of secondary invaders, and we are finding a few molds which seem to be secondary but not as innocuous as one often thinks they are

I thank Dr Coates for his agreement and his difference As to antrum puncture, if I had been going to enlarge on that I should have said that I never puncture an antrum and would not advise one being punctured without, first, a good roentgenogram, particularly with an acute condition, in which the mucous membrane is swollen The puncture goes through this, and the fluid may be forced into the swollen lining instead of the cavity of the antrum If one wishes to include the subacute stage as the next stage beyond that, when the membrane has shrunk and there is a large cavity filled with pus, then one may puncture it, if one likes, or wash it out from the normal ostium, or one can shrink the nose and use suction, any of the three methods frequently gives good results

As regards the obliterating operation on large sinuses that are pocketed off, my associates and I think that there is no danger of recurrence, osteomyelitic changes or secondary infection, although I still believe that osteomyelitis is a quality inherent in the infecting organism

DR GEORGE B WOOD, Philadelphia The puncture into the maxillary sinus is sure to bring more or less trauma into a mucosa that readily will pick up the infection I have seen severe hemorrhages following antral puncture I mention that as one of the dangers of puncturing with acute maxillary sinusitis I never do it

PRESENTATION OF A COLORED MOTION PICTURE OF THE LARYNX MADE BY THE INDIRECT METHOD OF LIGHTING DR GABRIEL TUCKER, Philadelphia

REVIEWING ROENTGENOGRAPHY OF THE SINUSES AND LARYNX DR FREDERICK M LAW, New York

The roentgen examination of the accessory sinuses and the larynx has shown comparatively little advance in recent years The only outstanding possibility is the development of the tomograph, by which structures at predetermined depths may be fairly well shown without the superimposition of extraneous shadows

The most important advance is the increasing ability of surgeons to interpret their own films properly They should now learn to appreciate the sources of possible erroneous interpretation due to technic and to anatomic departure from the average These changes are discussed The more capable the rhinolaryngologist is in criticizing the films, the better will be the work of the roentgenologist

DISCUSSION

DR GORDON B NEW, Rochester, Minn I should like to ask Dr Law one question, whether with this new method he has been able to determine involvement of cartilage in malignant disease With the difference in ossification of the thyroid cartilage, with this method can one tell when carcinoma has involved or perforated through the cartilage?

DR FREDERICK M LAW, New York In reply to the first question, I should say, "Yes" Regarding the second question, I should definitely say, "With limitations"

DR THOMAS C GALLOWAY, Evanston, Ill How long does the process take, and what is the dose of irradiation to the tissue?

DR FREDERICK M LAW, New York Chiefly in use is a meter calibrated for 65 kilovolts with 60 milliamperes Exposure is for one second with the tube at a distance of 30 inches (76 cm), so the dose is considerable If one has to cut many sections, especially in the chest, one has to be careful Four sections of the larynx are quite sufficient, and that is perfectly safe There is another way of making a tomograph by using pulley wheels instead of a lever, but it is not as efficient

DR CHARLES J IMPERATORI, New York I think the members of the association are greatly indebted to Dr Law for his exposition of the new methods of roentgen diagnosis I wish to speak particularly about this method, tomography, that was shown by Dr Leborne in New York just recently I am rather of the opinion that it is possible that laryngologists will change their ideas regarding the classification of growths in the larynx because of this method of viewing them roentgenologically, particularly views regarding prognosis will be changed, for the degree of infiltration can be seen, even though one is an endoscopist and may use a direct laryngoscope and see beneath the vocal cord and determine the possibility of subglottic infiltration, still with this method one gets a view of the piriform sinus, which frequently one never sees by either direct or indirect laryngoscopic examination I think it is definitely an advance in diagnostic methods

DR RALPH A FENTON, Portland, Ore May I ask a question of Dr Law, whether the method described is superior to that advocated by a European roentgenologist who inserts a covered film in the hypopharynx, behind the larynx? Has Dr Law had experience with that method?

DR FREDERICK M LAW, New York I have had no experience with it, but I can see the disadvantage I can see this advantage of the tomograph over that method It shows the entire larynx, the other shows merely a portion

DR GORDON B NEW, Rochester, Minn My associates and I have used both methods, and tomography has given us more information

DR FREDERICK M LAW, New York The difference in the level of the infiltrated area depends on the technic The section must be cut absolutely parallel with the long axis of the larynx Therefore, a change in that axis is going to change the depth of the infiltrated area, but if the section is wrong, the area will always appear shorter than it really is because of the tilting

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TONSILLECTOMY

LOCAL RESULTS AND INFLUENCE OF THE OPERATION ON SURROUNDING TISSUES

EDWARD H. CAMPBELL, M.D.

PHILADELPHIA

The problem of the recurrence of tonsillar tissue following tonsillectomy is one that has received much consideration. In spite of many articles drawing attention to the local results of this operation and investigations to reveal the causes of the recurrence of tonsillar tissue, tonsillectomized patients are constantly returning to those who operated on them, not only unimproved symptomatically but with throats showing the signs of incomplete and poorly performed operations. It is true that the surgical work on many of them has been performed by general practitioners, general surgeons and at times pediatricians, but on many others it has been done by specialists in otolaryngology. It is my purpose in this presentation to reveal the results of a statistical study of tonsillectomized persons as regards the recurrence of tonsillar tissue, injury to the faucial pillars and hypertrophy of pharyngeal lymphoid tissue and to draw a comparison between results obtained by practitioners and those obtained by specialists. No attempt will be made to evaluate the results from the symptomatic standpoint, and the usual review of the anatomy and the theories of the physiology of the tonsils will be omitted.

METHOD OF INVESTIGATION

During the years of 1936, 1937 and 1938 I examined 887 girls entering the freshman class at the University of Pennsylvania, in the Student Health Department. Their ages ranged from 18 to 21. The examination of the throat consisted in careful inspection of the tonsils or the tonsillar fauces (with the tongue well depressed and with the use of the pillar retractor when necessary), the posterior pharyngeal wall, the palate and the faucial pillars. With those on whom tonsillectomy had been performed, 621 in number, note was made whether or not lymphoid tissue was present in the tonsillar fauces. If so, the amount

From the Department of Otolaryngology, University of Pennsylvania

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and character of this tissue were observed and recorded. In 153 of the tonsillectomized students, in addition to a study of the tonsillar fauces, the amount of scarring of the tonsillar pillars, fauces and palate and the amount of pharyngeal lymphoid tissue were noted. With the latter group it was also recorded whether the operation had been performed by the family doctor or by a specialist.

When remnants of tonsils were found, they were classified as infected or noninfected. If the remnants appeared to be simply non-inflamed lymphoid tissue, without observable crypts containing exudate or without signs of being partially obscured by scar tissue, they were classified as noninfected. If the remnants showed signs of chronic inflammation, or if there were crypts containing exudative material, or if they were embedded and partially covered by fibrous scar, they were classified as infected.

A small amount of lymphoid tissue in the pharynx was not considered abnormal, but an excessive amount was recorded. A comparison was drawn between the condition of the throat in which the operation had been performed by a specialist and the throat in which the tonsillectomy had been performed by the family doctor. Minor scarring of the pillars and fossae was not recorded, but only such conditions as asymmetry of the palatal arch, distortion of the palate by fibrosis, loss of portions of the pillars or considerable fibrous scar in the tonsil fossa.

RESULTS

The accompanying tables give an outline of the results obtained from this investigation. Only 30 per cent of the 887 students examined had not had their tonsils removed. Of the 621 students who had been operated on, 77.3 per cent showed tonsillar remnants in the fossae. Of these, 66.6 per cent were placed in the class of noninfected remnants and 10.6 per cent in the class of infected remnants. In the group of 153 students who underwent more detailed investigation 54.9 per cent were found to have an excessive amount of lymphoid tissue in the pharynx and 22.8 per cent showed scarring of the palate, pillars or fossae. Of these 153 patients 67.3 per cent had been operated on by otolaryngologists and 28.7 by family physicians. Of the 103 students who had been operated on by specialists 74.7 per cent showed tonsillar remnants, 14.5 per cent showed scars and 25.3 per cent had no lymphoid tissue in the tonsillar fossae. Of the 44 students operated on by family physicians 79.5 per cent showed tonsillar remnants, 40.9 per cent showed scars and 20.5 per cent had fossae free from lymphoid tissue. One hundred per cent of the 21 students who had been operated on before the fourth year of age showed remnants of tonsillar tissue in the fossae, 73.4 per cent of the 94 students who had been operated on between the fourth and the tenth year of age showed lymphoid tissue

in the fossae, and 96.1 per cent of 26 students operated on after the tenth year of age showed recurrence of tonsillar tissue in the fossae.

STATISTICS AND OPINIONS ON THE RECURRENCE OF TONSILLAR TISSUE OBTAINED FROM THE LITERATURE

In 1923 Grichtel and Pearlman¹ found that in 25 per cent of their cases lymphoid structure was demonstrable in the tissues taken from the margins of the tonsillar bed recently operated on.

Baum² stated that the recurrence of lymphoid tissue in the tonsillar fossae is not due entirely to faulty technic, as there is extracapsular lymphoid tissue in the tonsillar fossae, in the pillars, in the plicae and between the base of the tongue and the tonsil.

Others—such as Spake,³ McMurray,⁴ Long,⁵ Roberts⁶ and Pierce⁷—have noted the recurrence of tonsillar tissue in various parts of the fossae after apparently complete enucleation.

Leshin and Pearlman⁸ examined microscopically 155 sections of the plica triangularis, plica supratonsillar and plica retrotonsillar and found lymphoid tissue in practically 50 per cent of these sections.

In a study of the end results of operations on tonsils and adenoids in children Nesbit⁹ examined 1,138 persons operated on. There was noted scarring of the faucial pillars in 753. The palate was scarred and drawn tightly across the fauces in 3. The uvula had been removed in 7. Distinct lymphoid nodules in the postpharyngeal wall were present in 463, and the lymphoid tissue in the lateral pharyngeal bands was hypertrophied in 473. The whole picture showed the tendency to compensatory hypertrophy of the lymphoid tissue in the oropharynx.

Epstein¹⁰ made careful observations on 540 children between the ages of 2 and 13 years before and at intervals for two years after

1 Grichtel, B. B., and Pearlman, S. J. Lymphoid Tissue in the Tonsillar Fossae Following Tonsillectomy, *Ann Otol, Rhin & Laryng* **32** 860, 1923.

2 Baum, H. L. Complications of Tonsil and Adenoid Operations. Their Prevention and Management, *Ann Otol, Rhin & Laryng* **28** 37, 1919.

3 Spake, L. B. The Recurring Tonsil, *J. Kansas M. Soc.* **22** 321, 1922.

4 McMurray, J. B. A Study of the Superficial and Deep Lymphoid Tissues of the Hypopharynx, *Atlantic M. J.* **30** 63, 1926.

5 Long, C. H. Recurrence of Tonsils After Tonsillectomy, *Illinois M. J.* **45** 226, 1924.

6 Roberts, E. R. The Tonsil Problem, *Arch. Otolaryng.* **6** 565 (Dec.) 1927.

7 Pierce, N. The Tonsil Problem, *Tr. Am. Laryng, Rhin & Otol. Soc.* **48** 267, 1921.

8 Leshin, N., and Pearlman, S. J. Are Tonsillar Recurrences Entirely Due to Faulty Operative Technic? *Arch. Otolaryng.* **13** 37 (Jan.) 1931.

9 Nesbit, E. The Post-Operative Complications and End Results of Tonsil and Adenoid Operations in Children, *Brit. M. J.* **2** 509, 1934.

10 Epstein, M. E. Factors Influencing the Results of Tonsillectomy and Adenoidectomy, *Am. J. Dis. Child.* **53** 1503 (June) 1937.

TABLE 1—*Results of the Examination of the Girl Students at the University of Pennsylvania*

Year Exami- nation Was Made	Number of Girls Examined	Age Range at Time of Examination	Number Who Had Not Had Tonsil- lectomy	Number Who Had Had Ton- sillectomy	Number Operated on Who Had Noninfected Remnants	Number Oper- ated on Who Had Infected Remnants	Number Operated on Whose Tonsillar Fossae Were Free from Tonsillar Tissue
1936	430	18 to 21	144	286	102	22	69
1937	241	18 to 21	59	182	121	20	26
1938	216	18 to 21	63	153	93	15	46
Total for the three years	887		266	621	414	63	141

TABLE 2—*Results of Detailed Study of One Hundred and Fifty-Three Girl Students Examined in 1938 Who Had Undergone Tonsillectomy*

Number operated on before the fourth year of age	21
Number operated on between the fourth and the tenth year of age	94
Number operated on after the tenth year of age	26
Number operated on twice	7
Number operated on at an age not ascertained	8
Number operated on by specialists (otolaryngologists)	103
Number operated on by family physicians	44
Number operated on showing scarring of palate, pillars or fossae	35
Number operated on showing an excessive amount of lymphoid tissue in the pharynx	84
Number operated on by specialists showing remnants	77
Number operated on by specialists showing clean fossae	26
Number operated on by specialists showing scars	17
Number operated on by family physicians showing remnants	35
Number operated on by family physicians showing clean fossae	9
Number operated on by family physicians showing scars	18
Number operated on before the fourth year of age showing remnants	21
Number operated on between the fourth and the tenth year showing remnants	69
Number operated on after the tenth year of age showing remnants	25

TABLE 3—*Summary of Results of Study in Percentages*

Percentage of 887 students examined who had not had tonsillectomy	30.0
Percentage of 887 students examined who had had tonsillectomy	70.0
Percentage of those operated on (621) whose fossae showed remnants	77.3
Percentage of those operated on (621) whose fossae showed noninfected remnants	66.6
Percentage of those operated on (621) whose fossae showed infected remnants	10.6
Percentage of those operated on (621) whose fossae showed no remnants	22.7
Percentage of 153 students operated on who showed an excessive amount of lymphoid tissue in the pharynx	54.9
Percentage of 153 students operated on who showed scarring of the palate, pillars or fossae	22.8
Percentage of 153 students operated on by specialists (otolaryngologists)	67.3
Percentage of 153 students operated on by family physicians	28.7
Percentage of 103 students operated on by specialists showing tonsillar remnants	74.7
Percentage of 103 students operated on by specialists showing fossae free from tonsillar tissue	25.3
Percentage of 103 students operated on by specialists showing scars	14.5
Percentage of 44 students operated on by family physicians showing tonsillar remnants	79.5
Percentage of 44 students operated on by family physicians showing fossae free from tonsillar tissue	20.5
Percentage of 44 students operated on by family physicians showing scars	40.9
Percentage of 21 students operated on before fourth year of age who showed tonsillar remnants	100.0
Percentage of 94 students operated on between the fourth and the tenth year of age who showed tonsillar remnants	73.4
Percentage of 26 students operated on after the tenth year of age who showed tonsillar remnants	96.1

tonsillectomy and adenoidectomy Of these, 336 showed hypertrophied lymphoid tissue This tendency to hypertrophy was especially evident in children under 4 years of age and least evident in those over 10 years of age

Miller¹¹ reported tonsillar tissue, in varying amounts, that had been left unknowingly or that had regenerated in 21.8 per cent of 133 tonsillectomized patients In all but 2 subjects the tissue was at the base or near the base of the fossa

Regarding the incidence of tonsillectomy, Glover¹² stated that it has been estimated that the number of operations of this type forms one third of the number of operations in general performed with patients under general anesthesia in the United States

Cunningham¹³ found that one third of 12,530 young white women who entered the University of California as students between 1920 and 1929 had had an operation for removal of tonsils

Paton¹⁴ noted that 42.9 per cent of 424 girls between the ages of 13 and 15 years who were examined on admittance to a boarding school had had their tonsils removed

Clark¹⁵ examined 143 patients who had been subjected to so-called tonsillectomy and found that 59 of this number had tonsillar stumps

In a study of 167 operations for removal of tonsils and adenoids Bradley¹⁶ reported that in only 18 per cent was eradication complete He quoted Coues as having found 30 per cent of tonsillectomized children suffering from chronic tonsillar hypertrophy

Rhoads and Dick¹⁷ examined 403 nurses entering training at the Presbyterian and Cook County hospitals and found fairly large pieces of tonsillar tissue remaining in the throats of 73 per cent of those who had had their tonsils removed These authors made bacterial counts on tonsils and tonsillar stumps and found that the stumps harbored more pathogenic bacteria per gram than tonsils removed for the first time

11 Miller, A A Study of One Hundred and Thirty-Three Tonsillectomies, *M Rec* **144** 367, 1936

12 Glover, J A The Incidence of Tonsillectomy in School Children, *Proc Roy Soc Med* **31** 1219, 1938

13 Cunningham, R L Normal, Absent and Pathologic Tonsils in Young Women A Comparison of Histories, *Arch Int Med* **47** 513 (April) 1931

14 Paton, J H P The Tonsil-Adenoid Operation and Some of Its Results, *Quart J Med* **22** 107, 1928

15 Clark, J P Results in a Series of Cases of Tonsillectomy, at the Massachusetts General Hospital, Three to Four Years After Operation, *Tr Am Laryng A* **35** 43, 1913

16 Bradley, W H The Tonsils and Nasopharyngeal Epidemics, *Arch Dis Childhood* **5** 335, 1930

17 Rhoads, P S, and Dick, G F Efficacy of Tonsillectomy for the Removal of Focal Infection, *J A M A* **91** 1149 (Oct 20) 1928

COMMENT

The noteworthy feature of the results obtained in this investigation is the extremely high incidence of recurrence of tonsillar tissue following tonsillectomy. When the tonsillar fossae of only 22.7 per cent of 621 persons who have had their tonsils removed are found free from tonsillar tissue, it cannot but reflect discredit on the operation and the operators. This should emphasize the statement made a few years ago by Holding.¹⁸ He said that general surgeons and general practitioners will continue to perform tonsillectomies until the majority of otolaryngologists justify their specialty by performing better operations. Since the investigations of electrocoagulation of tonsils by Shambaugh, Dougherty and Yonker¹⁹ and more recently by Yonker,²⁰ otolaryngologists have come to look on electrocoagulation of tonsils as unsuccessful, chiefly because of the failure to eradicate this tissue completely, but unless the figures presented in this paper for complete tonsillectomies can be materially improved the exponents of electrocoagulation will have considerable basis for criticism of surgical methods.

What reasons can be found for the high incidence of recurrence of tonsillar tissue? Probably the most outstanding reason is the inefficiently performed operation—that is, the tonsil is incompletely removed, a remnant being left in the fossa, usually in the lower pole. Why is a remnant left in such a high percentage of cases? The chief factors concerned in this are the following: (1) improper administration of the anesthetic, (2) inadequate illumination of the operative field, (3) unskilful assistance at the operation, (4) imperfect inspection of the fossae. All surgeons who perform tonsillectomy many times eventually reach the conclusion that tonsillectomy is not the easy or minor operation that it is so commonly thought but is dependent for its success on the factors mentioned. Unless the child is in the proper stage of anesthesia, with the tongue relaxed and the gag reflex abolished, it is extremely difficult to make the proper dissection of the tonsil and a careful search for remnants. The observation as to the proper stage of anesthesia applies particularly to the removal of adenoids. It is important also to have strong illumination, otherwise a tonsillar remnant will often be left in the lower pole. Of great importance is proper assistance at the operation. It is my opinion that for a good tonsillectomy more skilful assistance is required than for probably any other operation in the otolaryngologic field. In particular, efficient use of the tongue

18 Holding, A. F. The Need for Improved Technic in Tonsillectomy, *Laryngoscope* **45** 458, 1935.

19 Shambaugh, G. E., Dougherty, C. L., and Yonker, W. J. Electrocoagulation in the Practice of Otolaryngology, *S. Clin. North America* **17** 1157, 1932.

20 Yonker, W. J. Obstacles Encountered in Electrocoagulation of Tonsils, *Ann. Otol., Rhin. & Laryng.* **43** 117, 1934.

depressor and the suction tip to expose the operative site properly is necessary for good work. Incomplete or careless inspection of the area of operation is the reason for the recurrence. Proper anesthesia, illumination and assistance are the important factors in detecting small pieces of lymphoid tissue that may have escaped the surgical technic.

In addition to the inefficiently performed operation, other factors are concerned in the recurrence of tonsillar tissue. Among these may be mentioned (1) the possibility of regrowth of lymphoid tissue even though the tonsil has been completely removed, (2) proliferation of a lymph node in the fascia covering the tonsillar fossa, (3) hypertrophy of the lymphoid tissue in one of the plicae which may have been intentionally left, (4) extension of the lingual tonsil into the lower pole of the fossa.

It has been thought at times that the recurrent tonsil may have been a new growth of lymphoid tissue in a fossa in which the tonsil was completely removed. This seems unlikely, and it is probable that a tonsil completely removed with its capsule is never replaced by an actual new growth of lymphoid tissue. Roberts²¹ claimed that lymph nodes exist in the fascia which often lines the fossa after tonsillectomy and that these may hypertrophy and partially fill in the fossa with lymphoid tissue. He stated further that a chain of lymph nodes situated behind the posterior pillar occasionally undergoes hyperplasia and shows in the free border and anterior surface of the posterior pillar. Experimental work by Leshin and Pearlman⁸ demonstrated the existence of lymphoid tissue in the plica triangularis, plica supratonsillaris and plica retiotonsillaris. In the past it has been the practice of some operators to leave these plicae, particularly the plica triangularis, in doing tonsillectomy. If this practice is followed, there will be a recurrence of tonsillar tissue in the lower part of the fossa in a very large percentage of cases. The extension of lingual tonsillar tissue into the lower pole of the tonsillar fossa following tonsillectomy has been noted commonly. There is a tendency for all lymphoid tissue in the throat to undergo compensatory hypertrophy following tonsillectomy, and the lingual tonsillar hypertrophy is often in the direction of the faucial tonsillar area and may fill up half or more of the lower tonsillar bed.

In the study of the tonsillectomized students herein reported some emphasis was placed on the amount of scarring of the pillars, fossae and palate. It was observed that in those operated on by specialists there was considerably less scarring of these tissues than in those who were operated on by general practitioners. This is only what should be expected and emphasizes again the fact that the well performed tonsillectomy is not a simple operation. Although mild injury of the faucial pillars usually produces no symptoms, more severe injury may

21 Roberts, E. R. The Tonsil Problem, *Arch. Otolaryng.* 6:565 (Dec.) 1927.

cause considerable postoperative trouble. Destruction of the posterior pillar may interfere considerably with the function of the eustachian tube and the proper control of the throat in swallowing. It may also cause retractions of the soft palate, which may result in speech defects, as pointed out by Makuen.²² Marked injury to the pillars and palate may result in considerable contraction or even atresia of the nasopharynx. Scarring in the tonsillar fossae not only distorts the normal appearance of the throat but may enclose tonsillar remnants and is sometimes the basis for postoperative neuroses.

Such enclosed tonsillar remnants are often a greater menace to the patient both locally and generally than the original tonsils. It is not my intention to give any comparison of symptoms occurring before and after the tonsillectomy. This has been thoroughly reported by many writers. I shall emphasize only the point that recurrence of tonsillar tissue and the infection often present in the lymphoid tissue elsewhere in the throat, which has hypertrophied following the operation, are often responsible for the continuation of the symptoms which necessitated the tonsillectomy and often give more local discomfort and symptoms referable to a focus of infection than were caused by the original tonsil.

CONCLUSION

This presentation offers no new solution of the problem of recurrence of tonsillar tissue. The importance of a thorough technic has been emphasized before. Such a technic is the important factor in the prevention of recurrences. It is impracticable, if not impossible, to remove every particle of lymphoid tissue from the throat and nasopharynx. However, it is possible to remove the faucial tonsil completely with the plicae, the pharyngeal tonsil and the greater part of the macroscopic lymphoid tissue in the nasopharynx, pharynx and hypopharynx. This should be done with the greatest care in order that undue scarring of the tissues will not result. More efficient and careful surgical technic is necessary if otolaryngologists are to avoid the symptomatic recurrence and the possible criticism that comes with the return of tonsillar tissue.

SUMMARY

Tonsillectomized persons are constantly returning to otolaryngologists not only unimproved symptomatically but with throats showing the signs of incomplete and poorly performed operations.

A statistical study has been made to reveal the results of tonsillectomy as shown in the throats of 621 girl students entering a university during the years of 1936, 1937 and 1938.

²² Makuen, G. H. Relation of the Tonsil Operation to the Soft Palate and Voice, *Tr. Am. Laryng. A.*, 1911, p. 223.

Of these 621 students who had been operated on 77.3 per cent showed tonsillar remnants in the fossae

A more detailed study of 153 of these tonsillectomized students showed scarring of the palate, pillars or fossae in a large percentage of cases and an excessive amount of lymphoid tissue in the pharynx in the majority

Statistics on the recurrence of tonsillar tissue obtained from the literature are recorded and certain opinions expressed as to the reason for this recurrence

Factors influencing the efficiency of tonsillectomy and adenoidectomy are discussed in some detail

Other factors concerned in the recurrence of tonsillar tissue are briefly discussed and explained

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DISCUSSION

DR GEORGE B. WOOD, Philadelphia Two points in Dr Campbell's paper are of especial interest to me. One concerns the plica triangularis, that fold of mucous membrane which covers the front of the tonsil. Where its edge merges on to the free surface of the tonsil it is firmly attached but separated from the capsule of the tonsil by loose areolar tissue as it runs forward to fold over the palatoglossal muscle. Immediately posterior to its attachment to the tonsillar surface a deep crypt frequently exists. In his description of the plica Dr Fetterolf includes all the structures anterior to this crypt. If this description is accepted, the plica contains tonsillar tissue. If, however, the conception of the plica is just the fold of mucous membrane covering the anterior surface of the tonsil, there is no lymphoid tissue except in some instances, in which small superficial lymph follicles may be noted near the inferior pole. If left behind after tonsillectomy, these have the same clinical significance as the lymph follicles on the posterior pharyngeal wall.

The other point is in reference to actual recurrence of tonsillar tissue after tonsillectomy. Lymph follicles may develop in the scar six months to a year after the healing of the tonsillar wound. Again, I attach little significance to their presence as far as focal infection is concerned. Stumps of the tonsil itself left behind after an incomplete tonsillectomy are apt to be covered more or less by scar tissue and possess pockets with narrow mouths which are often a fruitful source of focal infection. As a rule it is not difficult to differentiate between these two types of tonsillar tissue in a throat that has been operated on.

NURSING, FEEDING AND PARENTERAL ADMINISTRATION OF FLUIDS

W E GROVE, M D

MILWAUKEE

In attempting to evaluate the importance of nursing, feeding and parenteral administration of fluids in the treatment of otitic sepsis it was not possible to go to the literature, for little has been written about these valuable adjuncts to treatment, which most physicians take for granted. In order to crystallize various opinions on these points a questionnaire was sent to representative otologists in various parts of the country, but, as so often happens with questionnaires, the replies were few. If, therefore, the more or less composite opinions expressed in this portion of the symposium do not meet with the approval of the hearers they will have ample opportunity to elaborate on them in the general discussion to follow.

NURSING

The opinions on the value of careful nursing vary from that of a physician who said, "It seems to me that good nursing is generally taken for granted," to the remark of Dr. Friesner, who wrote, "This enclosure was written by a Mt. Sinai nurse, to whose care, more than to my operative intervention, I owe the recovery of one of my friends." The selection of the nurse is important and should not be left to chance. In this selection one should not only be guided by the qualifications of the nurse but also by her personality in relation to that of the patient. Since a patient with otitic sepsis is usually irritable, it may be necessary to make several changes in nurses until the optimum combination is obtained.

Cooperation between the surgeon and the nurse is of prime importance and depends on both but mostly on the surgeon, who must at all times anticipate what may happen in the next twenty-four to forty-eight hours. This need not be discussed with the patient or his family, but the nurse in charge should know what complications to expect and what to watch for. The failure of patients to receive good nursing can in many instances be laid directly at the door of the surgeon. It is his business to explain to the nurse exactly what he expects her to do and that it is her duty to report to him immediately any unusual change in

This and the following papers were read as part of a Symposium on Care of the Patient After Operations for Sepsis of Otic Origin at the Forty-Fifth Annual Meeting of the American Laryngological, Rhinological and Otological Society, Inc., Chicago, May 9, 1939.

the patient's condition. It is poor cooperation between surgeon and nurse if he is not fully aware of some complication that has occurred since his last visit. The best type of nurse is one who carries out the surgeon's orders but gives the patient plenty of leeway in meeting his demands. Such a nurse can do much in maintaining the morale of the patient, who is uncomfortable, in pain, irritable and apprehensive. Without specifically discussing the condition with the patient the nurse can do much to allay apprehension by encouragement as to the ultimate outcome, the recovery of the hearing, the lack of disfiguring scars and so forth.

Certain routine duties of the nurse may, I think, be taken for granted. It is expected that she will know how and when to take the temperature and the pulse and respiratory rates and properly chart them. Even in these matters the surgeon must give her special orders if he wishes the data recorded more frequently than the usual hospital routine calls for. She is expected to keep the room at a proper temperature (about 68 F), to keep the patient out of direct drafts, to change gowns and bed linen when they become moist or soiled and, in general, to see that the patient does not become chilled. The covering must be warm enough to prevent chilling but light enough to avoid irritating the patient by the weight of the bed clothes. Most patients with otitic sepsis are already suffering from an infection of the upper part of the respiratory tract, which must be carefully watched to prevent pneumonia and bronchopneumonia.

Maintaining the general comfort of the patient is of great importance. In many patients with otitic sepsis the sternocleidomastoid muscle has been traumatized at operation. Any movement of the head creates pain. Nurses should be instructed to keep the patient in the dorsal position with the head slightly raised to lessen tension on the muscles of the neck. A "doughnut pillow" placed on top of the regular pillow may help much to relieve this strain. The nurse should exercise great care in lifting the head or changing its position. During the first few days the patient may be more comfortable if turned on the side opposite to that operated on and if the head is supported and bolstered with small pillows. She should, on order, limit the amount of company and sedulously guard against injudicious remarks by family or friends.

The nurse should maintain meticulous asepsis in the matter of daily dressings. She should provide sterile dressings, sheets and gloves for the surgeon. If he has any special idiosyncrasies in applying dressings or putting on bandages she should acquaint herself with them to avoid any delay in the one thing which the usual patient fears the most, the daily dressing. The usual antiseptic solutions for cleansing the wound and culture tubes should always be available on the dressing tray. If

moist dressings are called for the nurse must know how to apply them without getting the gown or bed clothes wet

The nurse in charge of a patient with otitic sepsis should be carefully instructed in the physical signs and symptoms of complications. She should watch for and recognize (a) drooping of one side of the face or inability to close the eye with paralysis of the facial nerve, (b) irritability and nuchal rigidity with a sudden rise of temperature with meningitis, (c) the "picket fence" temperature and chills with sinus thrombosis, (d) swelling below the dressings as a sign of Bezold's abscess, (e) Gradenigo's syndrome, (f) the appearance of aphasia, slow pulse and slow cerebration with abscess of the brain, (g) vertigo and nystagmus denoting labyrinthine invasion and (h) headache, for which she should have a profound respect no matter how trivial the complaint. She should not content herself with simply noting these observations on her chart but should immediately get in contact with the surgeon.

FOOD IN CASES OF OTITIC SEPSIS

Food is anything which when taken into the body serves to nourish or build up the tissues or to supply heat. Any diet should be well balanced. It should supply proteins, carbohydrates, fats, fluid and minerals. It is important to remember that the term nutrition means more than diet alone, for it also implies the transportation of assimilated food to all cells and tissues of the body. Therefore, the food offered the patient must supply all the constituents mentioned and still be offered in such form and amounts that it will be properly digested and assimilated. Most physicians are agreed that the diet should be liberal and of a high caloric content, although one of those to whom the questionnaire was sent expressed himself as not in favor of forcing convalescence as much as he had been taught while an intern.

The old adage "to force fluids and drown the fever" still seems to be good therapy, although under certain conditions even this dictum must be modified. The patient with otitic sepsis is functioning at a higher metabolic level than the healthy person. He is dehydrating himself more rapidly than normally, particularly if much nausea and vomiting are present. While nausea and other signs of acidosis are present one must content oneself with fluids, such as fruit juices, and with sugar given at frequent intervals. If this increases the nausea such nourishment must be given by other routes, such as the bowel or the vein or by hypodermoclysis. As nausea ceases the diet can be increased in bulk and in amount, but the consensus seems to be that small feedings every two hours are much better borne and assimilated than large meals at less frequent intervals. Raw fresh scraped beef and fresh meat juices are valuable for their nuclein content and to stimulate the formation of white blood cells. In the winter vitamins must be added to the diet, and if trans-

fusions have not been given the importance of blood-building and non-containing foods must receive serious consideration

These remarks cover the main objectives in the feeding of patients with otitic sepsis, and it should not be necessary to go into detail about the various articles of diet, but it should be remembered that nutrition in these cases actually means balanced metabolism

PARENTERAL ADMINISTRATION OF FLUIDS

The indications for blood transfusions and the parenteral administration of dextrose and Ringer's solution are sepsis, dehydration, acidosis and malnutrition

In every case of otitic sepsis the intake and output of fluid should be carefully charted, and when this cannot be accurately done I know of no better method of determining the need for parenteral administration of fluids than the concentration of the urine. I quote from Hartmann¹

regardless of the type of infection, we are likely to see, in infants and children, dehydration, fluid loss, with bicarbonate reduction and varying degrees of retention of waste products. If there happens to be some kidney damage

these chemical changes will become pronounced, and include great reduction in chloride, N P N of over 200 milligrams per 100 cc., and phosphate retention

In brief, if one has any kidney function at all worth speaking of, one can prevent the water changes and the electrolyte changes by the proper administration of fluids, but by fluids we do not mean simply normal saline solution or dextrose solution. One may have to give alkali which is generated inde-

pendently of any renal activity, and which takes care of an acidosis

Our own practice has been to supply in sufficient quantities such substances as sodium lactate, which can develop bicarbonate after metabolism, and Ringer's solution, which offers the body at least all the building stones necessary in the form of water, sodium, potassium, magnesium, calcium chloride, and alkali

Frank² stated the belief that the majority of patients with severe sepsis are best treated by intravenous injections. He stated a preference for a 5 per cent solution of dextrose in physiologic solution of sodium chloride, using 3 to 4 quarts (2.8 to 3.8 liters) daily for an adult and 2 to 3 quarts (1.9 to 2.8 liters) for a child. He stated a preference for the 5 per cent solution over the 10 per cent because, when given in large amounts, the latter spills over and is recovered from the urine. After giving the dextrose in saline solution for a time he alternates it with dextrose in triple distilled water to prevent edema due to excessive chlorides

Acidosis can easily be diagnosed by the nausea, vomiting and the presence of acetone and diacetic acid in the urine, and in the treatment of this condition nothing is of greater value than the parenteral administration of sugar solutions

1 Hartmann, A. F. Panel Discussion. Septic Thrombophlebitis of the Sigmoid Sinus, Medical Treatment, *Tr. Am. Acad. Ophth.* 42:443, 1937

2 Frank, I. Personal communication to the author

TRANSFUSIONS OF BLOOD IN THE CARE OF PATIENTS AFTER OPERATIONS FOR OTITIC SEPSIS

J MARION SUTHERLAND, M D

DETROIT

The part of the symposium which the president of the American Laryngological, Rhinological and Otological Society assigned to me deals with the use of transfusions of blood in the care of the patient after operations for sepsis of otitic origin. As a procedure of biologic therapy, the transfusion of normal or of immune blood plays an important part in both the prophylaxis and the treatment of surgical sepsis. But a rational evaluation of the various technics of blood grouping and methods of blood transfusion often presents serious difficulties to the laboratory worker as well as to the clinician. Experimental evidence offers only elementary aid in clarifying the problems, since septicemia in the animal varies considerably from that in man and biologic reactions are extremely difficult to duplicate in vitro.

The growing demand for closer association of scientific research and experience in the sickroom—for “confirming practical physiologic facts from controlled observations in man”¹—has been justified, within the last two decades, by the clarification of many heretofore unaccountable irregularities in the course of surgical sepsis. A cross section of present day literature is tangible evidence that the formerly detached schools of thought recognize in common that their ultimate purpose is the diagnosis and treatment of disease and that much of the accuracy in interpreting the clinical symptoms and the laboratory findings depends on an understanding of the physiologic principles involved.

This new outlook is of especial interest to the otolaryngologist, who must concede that the result in any given case of surgical sepsis depends not only on the biologic behavior and antigenic structure of the invading micro-organism but, to a greater extent, on the biologic behavior and defensive capacity of the innumerable cells and substances of the invaded patient's body—with the further complication that all these factors are inherently variable and hence interdependent.

Read as part of a Symposium on Care of the Patient After Operations for Sepsis of Otitic Origin at the Forty-Fifth Annual Meeting of the American Laryngological, Rhinological and Otological Society, Inc., Chicago, May 9, 1939.

¹ Doan, C. A. *Clinical Implications of Modern Physiologic Hematology*, St. Paul, The Bruce Publishing Company, 1936, p. 9.

FACTORS INFLUENCING SEPTICEMIA

With the first premonition of impending septicemia, a series of blood cultures is made, to determine, if possible, the causative organism and to estimate the degree of its pathogenicity, which means its ability to disturb the physiologic balance of the body fluids and tissues. An altered physiologic status requires an altered "clearing mechanism"² to digest or destroy the invaders parenterally and to neutralize their toxins. Normally, the circulating blood and the parenchymal organs evidence a remarkable capacity for removing foreign substances from the body tissues. Conversely, when the clearing mechanism is functionally impaired, invading organisms, even of low virulence, may produce septicemia. Ordinarily, micro-organisms, particularly streptococci of low virulence, may be intermittently present in the blood, as detected by cultures, when there is no clinical evidence of infection, especially in persons with chronic foci of infection in the tonsils, the sinuses, the apex of a tooth, the valves of the heart or the gallbladder. Concurrent with this bacteremia, acute mastoiditis may provide a rapid overflow of organisms, which cannot be effectively counterbalanced by the clearing mechanism, and sepsis results. Sepsis which persists after surgical drainage of the apparent focus of infection is due not so much to multiplication of bacteria in the blood as to constant invasion by organisms proliferating in foci which have not been eradicated, or which cannot be eradicated, by surgical intervention. Lillie³ stated, "It is extremely important that the pathologic conditions causing sepsis be thoroughly understood if stages of the disease are to be recognized."

HEMOLYSIS BY BACTERIAL PRODUCTS

Both pathogenic and nonpathogenic bacteria produce hemolytic substances that are excreted into the fluids in which they grow. During severe infectious processes, marked hemolysis occurs, especially in conditions accompanied by septicemia. The hemolytic bacterial toxins most frequently encountered in otitic sepsis are those produced by Streptococcus group A, Staphylococcus aureus and Pneumococcus type III. Wells⁴ considered

it probable that the bacterial "hemolysins" are all merely toxins with a particular affinity for red cells against some of these hematoxins antitoxic

2 Kolmer, J. A. Etiology, Prophylaxis and Treatment of Surgical Septicemia. A Discussion of the Principles Involved, Arch Otolaryng **26** 59 (July) 1937

3 Lillie, H. I., in discussion on Kopetzky, S. J. Panel Discussion. Septic Thrombophlebitis of the Sigmoid Sinus, A The Pathology, B The Bacteriology, C Immunological Treatment, Tr Am Acad Ophth **42** 432, 1937

4 Wells, H. G. Chemical Pathology, ed 5, Philadelphia, W. B. Saunders Company, 1925, pp 248

sera are obtainable, although there is some question as to how much of the antagonistic effect depends on true antitoxins and how much upon the cholesterol in the serum

Streptolysin and staphylolysin unite directly with the receptors of the red cells without the intervention of an intermediary body Zinsser⁵ reported that the

action of many bacterial poisons is selective. Most of these poisons excite inflammatory reactions if concentrated in any part of the body, but in addition to this, there is specific distribution which indicates that the poison goes into selective relationship with certain tissues and cells. This fact is illustrated by the bacterial hemotoxins which specifically injure the red blood cells of the infected individual and by such substances as the leukocidin produced by the *Staphylococcus aureus*, a poison which injures the white blood cells.

Wells⁴ stated

with streptococci, Lyall found that the hemolysin titer did not afford a criterion of virulence. No immunity to streptococci is produced in animals immunized with streptococcic hemolysin. Pneumococci produce an intracellular hemolytic toxin which is very labile and antigenic. Kammerer found that of a large series of organisms, only pneumococcus and *Strep hemolyticus* produce methemoglobin.

Stadie⁶ found that in pneumonia enough methemoglobin may be formed to cause a decrease in the oxygen capacity of the blood, the essential cause of cyanosis in pneumonia.

The first products of the splitting of the hemoglobin are the complex protein globin (which constitutes 94 per cent of hemoglobin), and hematin, the iron-containing compound. Some of the products of disintegration of hemoglobin seem to inhibit or destroy gram-positive bacteria. Many nonspecific hemolytic substances, such as acids and bases, also may be formed by bacteria as products of their metabolism. Staphylococci may produce hemolytic fatty acids by splitting fats. Wells⁷ stated, "The bacterial products may also modify coagulation and L. Loeb has found that *Staphylococcus aureus* [is] much more powerful in causing coagulation than any other [organisms] tested." Studying converse properties, Tunnichiff⁸ reported, "With the exception of some strains of *Staphylococcus aureus*, fibrinolysis appears to be peculiar to the hemolytic streptococcus." She found that this action appears to be associated with the virulent smooth

5 Zinsser, H. Resistance to Infectious Diseases, ed 4, New York, The Macmillan Company, 1931, p 41.

6 Stadie, W. C. Studies of the Blood Changes in Pneumococcic Infections, J. Exper. Med. **33** 627, 1921.

7 Wells,⁴ pp 353-355.

8 Tunnichiff, R. Effect of Dissociation of Streptococci on Their Fibrinolytic and Anticlotting Activity, J. Infect. Dis. **58** 92, 1936.

type The power is lost as the organism becomes rough Whipple⁹ maintained that coagulability decreases in sepsis because of the presence of an excess of antithrombin and that the antithrombin factor is often excessive in hemorrhagic conditions especially with hepatic impairment Antithrombin is often increased in diseases of the blood-forming organs e g, leukemia, possibly as a reaction to the products of disintegration of corpuscles Wells,⁷ however, stated

The fluidity of the blood in septicemia is probably dependent upon the appearance of the coagulation-inhibiting phase that follows the action of the products of cell destruction, including among them proteoses

ANEMIA DUE TO HEMOLYTIC AGENCIES

Secondary anemia occurring in the course of otitic sepsis may be explained largely by the hemolytic property of the invading bacterial products, hence, it presents quite different features from those of other secondary anemias The red corpuscles almost solely are attacked and the products of their disintegration are present in the plasma As a result, the plasma or serum may contain free hemoglobin, and if this is in large amounts it may escape into the urine The products set free by disintegration of the hemoglobin are present not only in the blood but also in the parenchymal organs particularly the liver and the spleen which accumulate iron Fatty changes occur in all these organs, with changes in metabolism which are similar to those observed in other forms of anemia With increased catabolism of protein the plasma chlorides are increased,¹⁰ the alkaline reserve decreased and the protective power of the serum against hemolysis by saponin, fatty acids, oleates and other products of suboxidation reduced¹¹ Suboxidation is manifested by the presence of acetone, oxybutyric acid and diacetic acid in the urine

PHYSIOLOGIC EQUILIBRIUMS OF THE BLOOD

Doan¹² stated

The individual types of cells in blood and tissues may be understood and their activities [effectively] influenced or controlled [only] as we acquire specific information concerning their fundamental physiologic relationships to each other and to the other cells and functions of the body Bone

9 Whipple, G H Hemorrhagic Disease—Septicemia, Melana Neonatorum and Hepatic Cirrhosis, *Arch Int Med* **9**:365 (March) 1912, II Hemorrhagic Disease Antithrombin and Prothrombin Factors, *ibid* **12** 637 (Dec) 1913

10 Steinfield, E The Plasma Chlorides in Anemia An Experimental Study, *Arch Int Med* **23**:511 (April) 1919

11 Clark, H M, and Evans, F A Studies with Lecithin and Cholesterol in Relation to the Antihemolytic Property of Human Serum, *Bull Johns Hopkins Hosp* **32** 113, 1921

12 Doan,¹ p 15

marrow, lymphatic tissue, spleen, liver, kidneys, gastro-intestinal tract, and some of the endocrine glands (pituitary, thyroid, adrenal) are now known to be intimately associated with [the] blood cell equilibria

Disturbance of normal balance in one aggregate of cells cannot be limited to that aggregate

As defined by Wells,¹³

The function of the blood [is] to maintain an equilibrium in the temperature, chemical composition, and osmotic pressure between all parts of the body

To the extent that every tissue is continually giving off something to the blood, we may consider that every organ is a factor in its formation

There are probably but few chemical substances occurring in the tissue-cells that do not also occur in greater or less amount in the blood. In addition there are the substances characteristic of the blood itself, besides a host of substances of unknown nature, apparently manufactured in response to the stimulation of substances entering the body from outside

Hence the circulating cellular elements of the blood constitute an essential and powerful increment in the defensive forces of the body

ORIGIN, MATURATION AND DISTRIBUTION OF THE VASCULAR CELLS

According to Doan¹⁴ hematologists agree "that all [the cells of the blood] take their first beginning from the mesenchymal cells of the mesodermal layer in the embryo" He stated, "The bone marrow throughout extrauterine life is the natural source of erythrocytes, thrombocytes and the three kinds of granulocytes" The neutrophilic granulocyte plays a major role in the mechanism of defense against infection and toxemia, the defensive value depending on its maturity and the integrity of its bactericidal ferments. The parent cell, the myeloblast, consists at first of a large nucleus surrounded by a small amount of clear cytoplasm. As the cell grows, the nucleus becomes relatively smaller, the cytoplasm, more abundant, the nucleoli disappear, the granules increase in number and are smaller, the nucleus is indented, and the cell shows motility for the first time. The nucleus separates into two or more lobes, united by a thin thread or filament. The older the cell is on leaving the marrow, the more lobes it shows (although the presence of more than five lobes is uncommon). The oxidase staining is now intense, indicating the high ferment content. Mitotic activity¹⁵ always occurs in an area of rich blood supply, between widely dilated venous sinusoids, in contradistinction to erythropoiesis, which occurs intravascularly in relatively anoxic areas in the marrow

¹³ Wells,⁴ pp 323-326

¹⁴ Doan, C. A. Current Views on the Origin and Maturation of the Cells of the Blood, *J. Lab. & Clin. Med.* **17** 887, 1932

¹⁵ Sabin, F. R., and Miller, F. R. Normal Bone Marrow, in Downey, H., *Handbook of Hematology*, New York, Paul B. Hoeber, Inc., 1937, pp 1791-1821

The phagocytic macrophages (clasmatocytes), while always present in the marrow, are quite as regularly and normally found in the spleen, liver and diffuse connective tissues. They are characterized by their size and ability to arise *in situ* throughout the body as the need presents. Lymphocytes and monocytes, the remaining elements which utilize the vascular bed as an avenue of distribution, develop in lymph nodes, spleen and the more diffuse lymphoid and connective tissues of the body.

HEMOPOIETIC REACTION TO INFECTION

The leukopoietic response to an invading noxa of infection and toxemia is a biologic response, in that the myeloid elements react initially to the irritating forces by an increase in concentration, to be followed by greater activity of the monocytes and lastly of the lymphocytic elements. This response is reflected in the reactions of the leukopoietic centers as well as in the erythropoietic tissue.

While it is admitted that the typical response of the leukopoietic system to infection is leukocytosis and neutrophilia, it must be remembered that an atypical response may result from a prior myeloid depression or an abnormal lymphocyte-monocyte ratio or that anemia may have preceded the development of otitic sepsis. The absence of hyperleukocytosis and neutrophilia concurrently with dynamic toxemia warrants neither an assumption that there is an inadequate immunologic response nor its converse.

In an evaluation of the blood pattern in otitic sepsis it is mandatory that the first consideration be given to the concentration of all the blood elements. Are they present in normal quantity, or are they decreased or increased? The second step is to compare the quantitative relation of the formed elements. Are the erythrocytes, hemoglobin and thrombocytes uniformly reduced, or is one of these elements appreciably depleted, thereby creating a marked disequilibrium? An identical appraisal is made of the white blood cell pattern, after which an intensive search is pursued for the detection of morphologic changes in the cellular components (Sharp¹⁶).

SHIFTS TO THE LEFT "TOXIC" GRANULATIONS WEAKENED DEFENSES

Whether or not the leukocytes are present in abnormal concentration, one of the primary reactions of the myeloid centers to infection is a tendency for the mature neutrophils to be replaced by those of a primitive status. Instead of polylobular neutrophils dominating the

¹⁶ Sharp, E. A. Hematopoietic Reaction to Infection unpublished data, personal interview with the author.

myeloid series in the peripheral blood pattern, metamyelocytes and myelocytes appear. This is designated as a "left" myeloid shift, and it may occur with neutrophilia, with neutropenia or when the total concentration of myeloid elements does not exceed the normal range, 58 to 66 per cent of the total number of white cells.

When toxemia is more than transitory, basophils and eosinophils are decreased to absence. The lymphocytes and monocytes, with exceptions, are inclined to decrease during the dynamic phase of infection, particularly when neutrophilia is appreciable. Having determined these points, the morphologic characteristics of the individual cell series are studied. Are "toxic" granulations present in the cytoplasm? Is the nucleus in each cell series normal in size and structure?¹⁶ Haden¹⁷ interpreted the qualitative changes in neutrophilic leukocytes as follows:

A neutrophilic leukocytosis with mature normal cells indicates the presence of an infection or toxemia to which the marrow is fully able to respond.

A neutrophilic leukocytosis with less mature cells or a significant increase in immature cells without an increase in the total count indicates either:

- a. Some difficulty in response of the marrow to an infection or toxemia.
- b. An overwhelming infection or toxemia requiring the marrow to deliver many granulocytes.

A leukopenia with immature cells indicates a depression of the marrow preventing the normal reaction to infection or toxemia.

The presence of "toxic" granulation with or without leukocytosis and regardless of the maturity of the cells, indicates, [the presence and the severity of] an infection or toxemia which is injuring the marrow.

The reappearance of the basophils and eosinophils presages convalescence.

CLINICAL PICTURE IN OTITIC SEPSIS

The clinical symptoms are manifested in varying degrees, depending on the extent and intensity of the infection and the causative pathogen. The common streptococcic or staphylococcic infection is, as a rule, first local, and the toxins alone pass into the blood. Symptoms of the invasion of the blood and the lymphatics by the bacteria usually set in within twenty-four hours and rarely later than the third or fourth day after the operation. There is a chill or chilliness with moderate fever at first, which may gradually or suddenly increase and is marked by daily remissions and even intermissions, with chills and drenching sweats. Sometimes symptoms suggesting involvement of the cerebrum dominate the picture. In other cases, gastrointestinal disturbances, such as nausea and vomiting, predominate. As the disease progresses the pulse becomes small, rapid and compressible. There may be periods of

¹⁷ Haden, R. L. The Interpretation of Qualitative Changes in Neutrophilic Leukocytes, *Cleveland Clin Quart* 5: 184, 1938.

delirium or marked mental prostration and apathy. There may be pallor or a yellowish tint of the face, lips and finger tips. The mouth is parched, the tongue is red at the margin and the dorsum is dry and dark. A mild or severe rash or even capillary hemorrhages may appear over the surface of the body.

INDICATIONS FOR TRANSFUSIONS OF BLOOD

In otitic sepsis toxic substances gradually saturate the parenchymal organs; the combustive processes are incomplete, resulting in subnormal elimination of waste products and the toxins of bacterial decomposition. The cellular elements of the body are in drastic need of oxygen, nutrition and water, and since physiologic equilibrium depends on an adequate supply of oxygen, nutrition and fluids, which can be furnished only by the blood, it is reasonable to assume that whole human blood is theoretically and practically the ideal fluid for transfusion. The amount administered, the interval between transfusions, the condition of the patient, the qualitative changes in the blood and especially a reduced concentration of hemoglobin should all be correlated with the indications for transfusion.

The purpose of transfusions of blood is to counteract the following conditions:

- 1 Hemorrhage traumatic secondary to the local disease or secondary to operation
- 2 Shock, surgical¹⁸ or hemolytic¹⁹
- 3 Anemia complicating the local disease
- 4 A progressive, falling concentration of hemoglobin
- 5 Toxemia complicating mastoiditis or thrombosis of a sinus or jugular vein
- 6 Debilitation with or without secondary anemia
- 7 A loss of plasma proteins associated with acute anhydremia especially in infancy and childhood²⁰
- 8 Acute hemolytic anemia secondary to the use of sulfanilamide for which blood transfusions should be given until the blood level is restored (Shurly²¹)

18 McFee, W. F. and Baldrige, R. R. Post-Operative Shock and Shock-Like Conditions. Treatment by Infusion in Large Volume. *Ann Surg* **91**:329, 1930.

19 Krampf, F. Hemolytic Shock Following Blood Transfusion. *Wien klin Wchnschr* **51**:407, 1938.

20 Hartmann, A. F. Panel Discussion. Septic Thrombophlebitis of the Sigmoid Sinus. Medical Treatment. *Tr Am Acad Ophth* **42**:443, 1937.

21 Shurly, B. R. Personal interview with the author.

THERAPEUTIC VALUE OF TRANSFUSIONS OF BLOOD

In general, the therapeutic value of transfusions of blood depends on the following actions

1 They supply serum and plasma proteins which aid in restoring colloid pressure, blood volume and water balance within the vessels, thus diluting toxic blood

2 They provide immediately an available supply of oxygen carriers

3 They furnish a quantity of fresh leukocytes for the elaboration of bactericidal enzymes, opsonins which render organisms susceptible to phagocytosis, agglutinins which flocculate organisms, thus favoring phagocytosis, and bactericidal plasma or serum to dissociate²² or degrade bacteria to a form which can be more readily phagocyted, also they furnish such nonspecific bactericidal agents as the leukins and the plakins

4 They stimulate the hemopoietic centers thus aiding the formation of white and red cells

5 They support hepatic function, which is essential to the blood and the hemopoietic efficiency

MINERAL AND CARBOHYDRATE ADJUVANTS TO BLOOD THERAPY

1 Since "water regulation of the body is intimately linked with the metabolism of sodium and potassium and [with] the function of the kidney,"²³ and since in severe septic conditions there is as a rule, considerable dehydration, due to forced loss of extracellular fluids and bases, physiologic solution of sodium chloride or Ringer's solution may be given intravenously to maintain fluid balance. Unless urgently needed, no more than 500 cc is given in one transfusion. Hypertonic solutions are employed only when specifically indicated. Should a blood transfusion be required during the period of intravenous therapy, it may be given without withdrawing the needle, unnecessary venipuncture thus being avoided. When a secondary operation is necessary for severe or prolonged otitic sepsis it is advisable to give a transfusion of 150 cc to 250 cc of whole blood for adults and 100 cc to 150 cc for children preoperatively. A similar amount should be administered immediately after the operation and the procedure repeated every second day as indicated. Loss of blood in such patients will produce symptoms out of all proportion to the amount of blood lost at the time of operation. Loss of other body fluids at this time may further complicate the picture. Shock may thus be prevented, and what appeared

22 Mellon, R. D. A New Approach to the Therapeutics of Hemolytic Streptococcus Infection, *Proc Soc Exper Biol & Med* **34** 474, 1936

23 McCance, R. A. Medical Problems in Mineral Metabolism (Goulstonian Lectures), *Lancet* **1** 643, 704, 765 and 823, 1936

to be a poor surgical risk may now become a good one. Blood volume is bound up with hemorrhage and shock. Lewisohn²⁴ asserted that if both transfusion and surgical procedure are necessary, the transfusion should be given first.

2. The blood sugar level should be maintained by the addition of dextrose to the sodium chloride solutions as indicated. Fats and carbohydrates are the first drawn on and later the proteins, in an effort to provide water for the maintenance of the normal fluid content. When conditions arise which tend to lower or raise the blood volume, either the hydrostatic or the osmotic pressure or both are altered, and it is through such changes that the blood fluid is automatically restored to its previous level (Best and Taylor)²⁵

According to Hartmann²⁶ the course of otitic sepsis, especially in infancy and childhood, may be complicated by (1) "severe disturbances of water balance and acid base balance," (2) depletion of carbohydrate stores permitting ketosis and even severe hypoglycemia, which interferes "with efficient circulation of the blood," (3) lowering of plasma volume through "loss of water" or loss of protein from the plasma" and (4) "ineffectual circulation because of loss of red cells from anemia." Hartmann stated also

One may find acute anhydremia with circulatory failure in the presence even of edema, because the level of plasma protein is not sufficient to bring water back from the tissue into circulation, and to correct a change like this will require the transfusion of whole blood, with sufficient plasma, or of plasma itself repeated often enough, or the transfusion of some substitute for plasma such as [a 6 per cent solution of] acacia.

SELECTION OF A COMPATIBLE DONOR

The routine procedure of a preliminary blood grouping followed by a direct matching of the donor's cells and the recipient's serum has been firmly established. With high titer serums, this matching detects the presence in the recipient's serum of atypical agglutinins which may be active against the prospective donor's cells. When the same patient is to be given more than one transfusion, even if the same donor is to be used again, the cross agglutination should be repeated before each transfusion. In addition to compatibility, the quality of the donor's blood should be appraised for hemoglobin content and dyscrasias of blood and bone marrow. Collier²⁶ and others have advocated a careful medical history, physical examination and laboratory studies to exclude

24 Lewisohn, R., cited by Wiener,⁴⁷ p. 51.

25 Best, C. H., and Taylor, N. B. *The Physiological Basis of Medical Practice*, Baltimore, William Wood & Company, 1937, pp. 22-31.

26 Collier, W. D. *The Uses and Abuses of Transfusion*, Ohio State M. J. 34: 1111, 1938.

prospective donors with transmissible diseases, "such as syphilis, malaria, virus, bacterial and allergic diseases" It is now known that the serologic test for syphilis is not sufficient, since "the chancre may be present and the blood full of spirochetes although the blood serology is not yet positive" It has been found advisable to exclude the "emotionally unstable donor" and donors who have partaken of food or alcoholic beverages within five hours before the taking of blood

CONTRAINDICATIONS FOR BLOOD TRANSFUSIONS

With the altered conceptions of contraindications for blood transfusions which have evolved with the newer collaboration of research worker and clinician within the last two decades, the otolaryngologist finds increasing need to consult the hematologist, the internist the pathologist and the pediatrician in cases of precarious otitic infection Obviously the otolaryngologist does not attempt the independent supervision of any intravenous injection when there is pulmonary edema or serious myocardial degeneration In such cases transfusions, if given, must be administered at an extremely slow rate and only by trained transfusionists

The frequent injury of the heart muscle by bacterial poisons or the irregular parenchymatous changes in various organs may be determined, according to Zinsser,²⁷ by functional activity and increased metabolism In many infectious conditions the bacteria themselves pass through the kidney into the urine, and "renal injury may result from the actual presence of the bacteria in the kidney," as well as from the lesions produced by bacterial poisons in the course of excretion Severe otitic infections requiring transfusions may be seriously complicated by acute nephritis The older opinion that blood transfusion should not be used in cases of nephritis has been refuted by many authors Cooksey²⁸ asserted

Certainly in the early days of acute hemorrhagic nephritis, blood is of very real assistance in any kind of nephrotic edema, even that of chronic Bright's disease, blood may sometimes be given to raise the serum protein levels with value However, always caution must be used in transfusing cases of nephritis, for if a severe reaction should occur, with further damage to the renal tubules, a grave condition may result

Others withhold transfusions from the asthenic and the aged and consider certain dyscrasias of the blood, as leukemia, a contraindication to transfusion except as a temporary stimulant

²⁷ Zinsser,⁵ p 46

²⁸ Cooksey, W B Recent Advances in Blood Transfusion, J Michigan M Soc 38 409, 1939

METHODS OF TRANSFUSION OF BLOOD

The following forms of blood for transfusion have been recommended and used in the treatment of sepsis of otitic origin and in other conditions requiring blood therapy

- 1 Whole unmodified blood (direct transfusion)
- 2 Citrated or modified blood (indirect transfusion)
- 3 Specifically immunized blood (impractical except for prolonged sepsis)
- 4 Nonspecifically immunized blood
- 5 Immunized blood and blood serum from convalescent donors

A recent survey of blood transfusion in America, compiled by Levine and Katzin²⁹ from data received from three hundred and fifty approved hospitals, evidenced a general increase in the number of transfusions being given and a decided preference for the citrate method. Several reasons are given for the popularity of this method, chief of which is the expressed belief that no special precautions are required. The authors stated

For patients suffering from infections of the blood stream, the citrate method is used, apparently because it affords absolute protection to the donor. On the other hand, some of the advocates of the direct method believe that the advantages of the citrate method are more apparent than real and maintain that whole blood is preferable for patients with septicemia.

Bipartisan authors have found no essential difference in therapeutic value between modified whole blood and unmodified whole blood when transfused. To ameliorate and control the bacteremia or septicemia complicating thrombosis of the lateral sinus, Coates, Ersner and Persky³⁰ advocated the use of blood transfusions and affirmed "It is immaterial whether one uses the whole or the citrated blood." Small transfusions (in adults, 150 to 250 cc, in children and infants, "1 to 1½ cc of whole blood per pound of body weight") may be given preoperatively or postoperatively "and should be repeated at frequent intervals, particularly where the infection is very severe." Indications for postoperative transfusions are a "persistent septic type of temperature, increasing anemia, or a marked loss of resistance."

Lillie³¹ advised, for a "very sick and washed out" patient,^{31a} delaying operation "in order to improve the general condition by using fluids

29 Levine, P., and Katzin, E. M. A Survey of Blood Transfusion in America, J. A. M. A. **110**:1243 (April 16) 1938.

30 Coates, G. M., Ersner, M. S., and Persky, A. H. Lateral Sinus Thrombosis, with Review of the Literature, Ann. Otol., Rhin. & Laryng. **43**:419, 1934.

31 Lillie, H. I. The Surgery for Sepsis of Otitic Origin, in Nelson New Loose-Leaf Surgery of the Ear, New York, Thomas Nelson & Sons, 1938, pp. 261-287.

31a Lillie, H. I., in discussion on Hartmann,²⁰ p. 455.

and blood transfusions" In the postoperative treatment of otitic sepsis he stressed the importance of carefully determining the concentration of hemoglobin, as a definite decrease in this element of the blood indicates a serious disturbance of physiologic balance "One cannot set up a definite standard for the concentration of hemoglobin at which transfusion of blood is indicated, but the falling concentration of hemoglobin and the general appearance of the patient are rather good indices"

In the postoperative treatment of thrombosis of the lateral sinus, Kopetzky³² concurred with others in the use of blood transfusions for complicating anemia but expressed disagreement with those who prescribe blood transfusions to counteract a septic temperature He stated the belief that a persisting septic temperature curve indicates that the focus of infection has not been eradicated and that repeated transfusions are a hindrance to speedy recovery On the other hand, Pemberton³³ found that transfusions given shortly after, and in some instances before, the operation offer a reasonable means of combating acute toxic and septic conditions In comparative view, Friesner³⁴ asserted that blood transfusions contribute only indirectly to the cure of otitic sepsis and "contribute no more than food or any other supportive measure does" Fenton³⁵ advocated, for children, supportive transfusions of 150 cc of "whole citrated blood" preceding the operation and transfusions repeated every third or fourth day postoperatively He found "no special reason to crowd transfusions unless the hemoglobin index has fallen below 60" After surgical treatment of the mastoid, the sigmoid sinus and the jugular vein, Fuistenberg and Maxwell³⁶ gave the patient supporting treatment including small transfusions of "whole blood" at two or three day intervals, from different donors Reduced iron in doses of 0.5 Gm was administered orally three times a day, and fluids were forced to 4 or 5 liters a day for adults Patients unable to take adequate fluids by mouth were given a continuous intravenous injection of 5 per cent dextrose Dissipated body chlorides were replaced by physiologic solution of sodium chloride administered intravenously

32 Kopetzky, S. J. Acute and Chronic Otitis Media and Sinus Thrombosis, *Arch Otolaryng* **10** 302 (Sept) 1929

33 Pemberton, J. de J. Blood Transfusions, *Surg, Gynec & Obst* **28** 262, 1919

34 Friesner, I. Infections of the Middle Ear. Acute Systemic Infections from the Ear, *Arch Otolaryng* **14** 257 (Sept) 1931

35 Fenton, R. A. Some Observations on the Management of Infections of the Blood Stream from Mastoiditis, *Arch Otolaryng* **25** 618 (June) 1937

36 Maxwell, J. H. Thrombosis of the Sigmoid Sinus. Clinical Analysis, *Arch Otolaryng* **25** 184 (Feb) 1937, Management of the Septic Patient with Otitis Media, *J. A. M. A* **110** 1536 (May 7) 1938

IMMUNE BLOOD AND SERUM THERAPY

In view of the increasing use of specific therapeutic agents in the supplementary treatment of surgical septicemia, Wood³⁷ emphasized the importance of determining the exact nature of every invading organism. This is a prime essential for specific therapy, whether biologic or chemical. With such information recorded, the person who has recovered is a possible donor of blood for another person suffering from the identical infection. The value of the immune substances in the new blood depends on its specificity. [Hence,] not only the type but the strain of the [invading] bacteria should be determined exactly and recorded.³⁷

The suggestion recently made by Gill³⁸ for a system of universal specific therapy would utilize the antibodies of patients who have survived similar infections. He reported

Transfusion of immunized whole blood should be given for its prophylactic value to persons with lowered resistance, as indicated by the opsonic index and the blood picture. In cases of infection of the blood stream and the fixed tissues, transfusion of immunized whole blood has a definite curative value and should be administered every other day until the well-being of the patient justifies discontinuance.

In some instances the direct method of transfusion was used, anti-streptococcus serum, given intramuscularly, was utilized freely, and a solution of dextrose and sodium chloride was used intravenously.

In the postoperative treatment of otitic septicemia, Lynch³⁹ selected as donors those who had had scarlet fever, erysipelas or septic sore throat, and whose serum showed the highest opsonic index, providing the blood grouping and cross matchings indicated suitability. Small transfusions, from 150 to 200 cc., were administered every eight hours for twenty-four hours and "then 300 cc. daily on every other day as the patient's condition warrants." In addition, he gave injections of antitoxin in cases of severe toxicity. He reported gratifying results in a series of 10 cases. Reverchon⁴⁰ also reported favorable results in regulating septic temperature and in improving the general condition in patients treated similarly.

Crocker, Valentine and Brody⁴¹ presented "a preliminary report on fifty-two cases of septicemia and acute infections treated with hemog-

37 Wood, E. L., in discussion on Gill³⁸

38 Gill, E. G. Infection of the Blood Stream, Arch. Otolaryng. **27** 67 (Jan) 1938

39 Lynch, M. G. Immunotransfusion in Otolaryngology, New Orleans M. & S. J. **91** 89, 1938

40 Reverchon. L'immunotransfusion dans le traitement de la septicémie d'origine auriculaire, Ann. d'oto-laryng., 1932, p. 1133

41 Crocker, W. J., Valentine, E. H., and Brody, W. Hemography-Controlled Nonspecific Immunotransfusions in the Treatment of Septicemia and Other Acute Infections, J. Lab. & Clin. Med. **20** 482, 1935

raphy-controlled nonspecific immunotransfusions" The object of their paper was stated as follows

1 To show that cases, in which this treatment is indicated, can be diagnosed and controlled best when shiftograms are used in conjunction with clinical findings and other laboratory data

2 To show that nonspecific immunotransfusions may be used successfully in the treatment of acute infections which are of such rapid progress and great severity that there is not time to prepare a specifically immunized donor, vaccine or other biologic substance

3 To point out the fact that unless there is adequate natural or surgically established drainage of the foci of infection, the beneficial effect of the nonspecific immunotransfusions is only transitory

Daily hemograms were done and charted and each case was closely controlled by hemograms before and after transfusion In this manner a change of the patient's condition for better or worse was often detected several hours before it had appeared clinically A second donor could then be prepared for transfusion while the patient's condition was still fair

They expressed a preference for the direct method of transfusion and stated

In severe rapidly progressive infections small transfusions (100 to 250 cc), at intervals of six to twelve hours are of value Transfusions are repeated daily until the shift is forced right to a Schilling index of less than one Of 52 patients thus treated 25 recovered and 27 died Five reasons appear for failure of recovery treatment too long delayed, overwhelming infection, insufficient number of donors available, impossibility of adequate drainage and extensive pathology of incurable character

J E Gordon⁴² advocated the use of whole unmodified blood and blood serum from persons recently convalescent from scarlet fever to combat scarlet fever and its complications, including otitic sepsis Blood was not used earlier than the fifteenth day of the donor's illness Usually one transfusion produced the desired effects, in other cases two or three transfusions were required as indicated Harrell⁴³ more recently reported favorable results after injection of 30 cc of convalescent human serum into the fascia lata in cases of toxic and septic mastoiditis due to the hemolytic streptococcus, both contagious and noncontagious His findings indicate that "convalescent serum contains anti-bodies which may not be bacteriologically specific, but therapeutically specific against streptococcic infection, which may clinically be a different disease from that from which the donor has recovered"

42 Gordon, J E Immunotransfusion in Scarlet Fever, *J A M A* **100** 102 (Jan 14), 1933

43 Harrell, V Hemolytic Streptococcic Mastoiditis in Contagion and Non-contagion, *Ann Otol, Rhin & Laryng* **46** 194, 1937

W H Gordon⁴⁴ and others who used specifically immunized blood in the treatment of typhoid fever and scarlet fever found a high incidence of recovery

Tillett and Stock⁴⁵ "demonstrated that sera from patients acutely ill with different [streptococcic] infections were capable of destroying hemolytic streptococci of the *beta* type" but that the bactericidal action disappeared "when the stimulus of active disease was no longer present

It was noted, in addition, that the streptococcidal potency was greatest in samples of sera derived from patients with the most severe types of illness" Tillett⁴⁶ stated

The bactericidal property of the human serum which Stock and I have studied differs from an antibacterial immune response in the ordinary sense of the word. The action which we observed is present only during the acute phase of illness and disappears during convalescence, when specific antibodies usually make their appearance. Consequently, if the property which we observed has any value, it cannot be transferred from convalescent patients, since it is not there at that time

The question of immunity to the hemolytic streptococci is unusually complicated

For example, strains of hemolytic streptococci appear to have a type specificity which is in some respects comparable to the type specificity of pneumococci but which also differs from it in some respects. Twenty-eight different types of hemolytic streptococcus have been described by Griffiths. It is apparent from this fact alone that a so-called immune donor would have to have immunity corresponding to the type of organism infecting the prospective recipient

ADVERSE EFFECTS OF TRANSFUSIONS OF BLOOD

Although much has been learned concerning the cause of adverse post-transfusion reactions, there are some which cannot always be avoided even in the absence of contraindications. It is generally conceded that the origin of most of these reactions is referable to (1) the use of specifically incompatible blood or (2) the presence in the donor's blood serum of nonspecific protein components and other substances which when transfused produce reactions suggesting allergic phenomena. In addition to these, Wiener⁴⁷ has suggested as possible causes of post-transfusion reactions (3) the use of citrate for transfusions, (4) incipient coagulative changes in the transfused blood, (5) minor irregularities in blood grouping not detected by routine tests, e g anomalous

44 Gordon, W H. The Use of Immunotransfusions in the Treatment of Scarlet Fever and Typhoid Fever, unpublished data

45 Tillett, W S, and Stock, C C. Bactericidal Action of Human Serum on the Hemolytic Streptococcus, *J Exper Med* **66** 617, 1937

46 Tillett, W S. The Question of Immunity to Hemolytic Streptococci, personal communication to the author

47 Wiener, A S. Blood Groups and Blood Transfusions, Springfield, Ill., Charles C Thomas, Publisher, 1935, pp 56-61, 26-35 and 44

agglutinins not conforming to the scheme of the four blood groups, (6) foreign matter derived from the apparatus, (7) the introduction of too large an amount of blood, which leads to overburdening of the circulation and even to pulmonary and cerebral edema, (8) the development of isoantibodies in the plasma of persons who had previously received injections of compatible blood and (9) indiscriminate use of the universal donor, group O, whose agglutinins are of high titer. Another cause may be (10) the factor suggested by Polayes and Lederer⁴⁸

Weak agglutinogens or agglutinins in the recipient's blood especially in the case of infants may also lead to false group determinations. Failure to recognize this fact has resulted in reactions after repeated transfusion in children in whom the agglutinins developed or became active after the first transfusion.

1 In their survey of hospitals, Levine and Katzin²⁰ found

The largest group of [post-transfusion] accidents was attributable to the injection of incompatible blood. In the vast majority of instances the grouping serums employed are not potent and/or the persons performing the tests are not sufficiently trained.

In discussing post-transfusion reactions, Wiener^{48a} asserted that it is "practically impossible to miss positive reactions if the testing sera are of high titer" but that stock serum may be of high titer when stored in vials yet the titer may fall before the serum is used. Since serum deteriorates, even when kept under sterile conditions, the contents of each vial must be tested against known cell suspensions before use. However, Gonzales, Vance and Helpen⁴⁹ stated

Incompatible bloods have been employed for transfusions either because the iso-agglutination tests were not performed with sufficient care, or because an aberrant hemolysis in the serum of the donor could not be demonstrated in the preliminary tests.

The effect of transfusing a specifically incompatible blood into the circulation of a recipient is to cause an agglutination and hemolysis of the red blood cells followed by the blocking of the renal tubules with blood pigment, [leukocytes and other desquamated cells].

Bordley⁵⁰ concluded from personal study

of the complete records of three cases and from the available information concerning fourteen others that the characteristic delayed reaction following transfusion

48 Polayes, S. H., and Lederer, M. Reactions to Blood Transfusions, *J Lab & Clin Med* **17** 1029, 1932.

48a Wiener,⁴⁷ p. 26.

49 Gonzales, T. A., Vance, M., and Helpen, M. *Legal Medicine and Toxicology*, New York, D. Appleton-Century Company, Inc., 1937, pp. 422-423.

50 Bordley, J., III. Reactions Following Transfusion of Blood, with Urinary Suppression and Uremia, *Arch Int Med* **47** 288 (Feb) 1931.

[in these cases was] dependent on the injection of incompatible blood
[, and] that most of the signs and symptoms [of] reaction
develop from the severe functional damage that the injected blood inflicts on the
kidneys

However, definite incompatibility was established in only 6 of the 17 cases reported. From their observations of 2,500 transfusions, Polayes and Lederer⁴⁸ asserted

To ascribe all reactions of this type to incompatible blood would not account for [certain fatal cases in our experience in which the transfused blood was found by previous cross agglutination tests to be compatible with the recipient's] .

The changes noted in the tubules of the kidney, which are so similar to those of the so-called tubular nephritis, described as occurring in pyloric obstruction with vomiting, has lent support to the theory that the post-transfusion renal insufficiency follows a loss of chlorides incident to vomiting and its consequential nitrogen retention

DeGowin's⁵¹ analysis of 3,500 blood transfusions attributed 7 deaths directly to the transfusions, 5 to renal insufficiency and 2 to pulmonary edema. He reported also 3 recoveries in cases in which the patient had developed hemolytic reactions without renal insufficiency. He concurred with other authors that the present laboratory tests as routinely applied are inadequate in certain instances to detect incompatibilities of bloods, which, after transfusion, become manifest clinically. "In view of our ignorance of the mechanism of the renal damage it would seem that the only safe procedure at present is to alkalinize the urine prior to transfusion."

Gonzales, Vance and Helpner⁴⁹ further noted

The symptoms [of renal lesions due to the transfusion of a specifically incompatible blood are] tingling pains over the entire body, fullness of the head, oppressive precordial pain, and severe pain in the lumbar region. The face is markedly cyanotic, the respirations are labored, the pulse is slow, 20 to 30 times a minute, a chill, high fever (103° to 107° F), jaundice, delirium and shock supervene. Hemoglobinuria is a constant finding, and often anuria occurs.

Uremia, coma and death follow from four to fifteen days after the transfusion.

2. In contradistinction according to the same authors, "Hemolysis, hemoglobinuria and anuria are absent" in anaphylactic or proteolytic reaction due to the presence in the donor's blood serum of nonspecific proteins and other substances which when transfused may "elicit

⁵¹ DeGowin, E. L. · Grave Sequelae of Blood Transfusions. Survey of Three Thousand and Five Hundred Cases, *Ann Int Med* 11:1777 1938

an allergic response from the recipient" Results of adverse reactions which develop during transfusion or shortly afterward are "high fever, asthma from intense bronchiolar spasm, involuntary evacuation and death in a few hours from asphyxia"

3 A survey of hospitals using the citrate method exclusively indicates that these institutions reported either few or no reactions or else

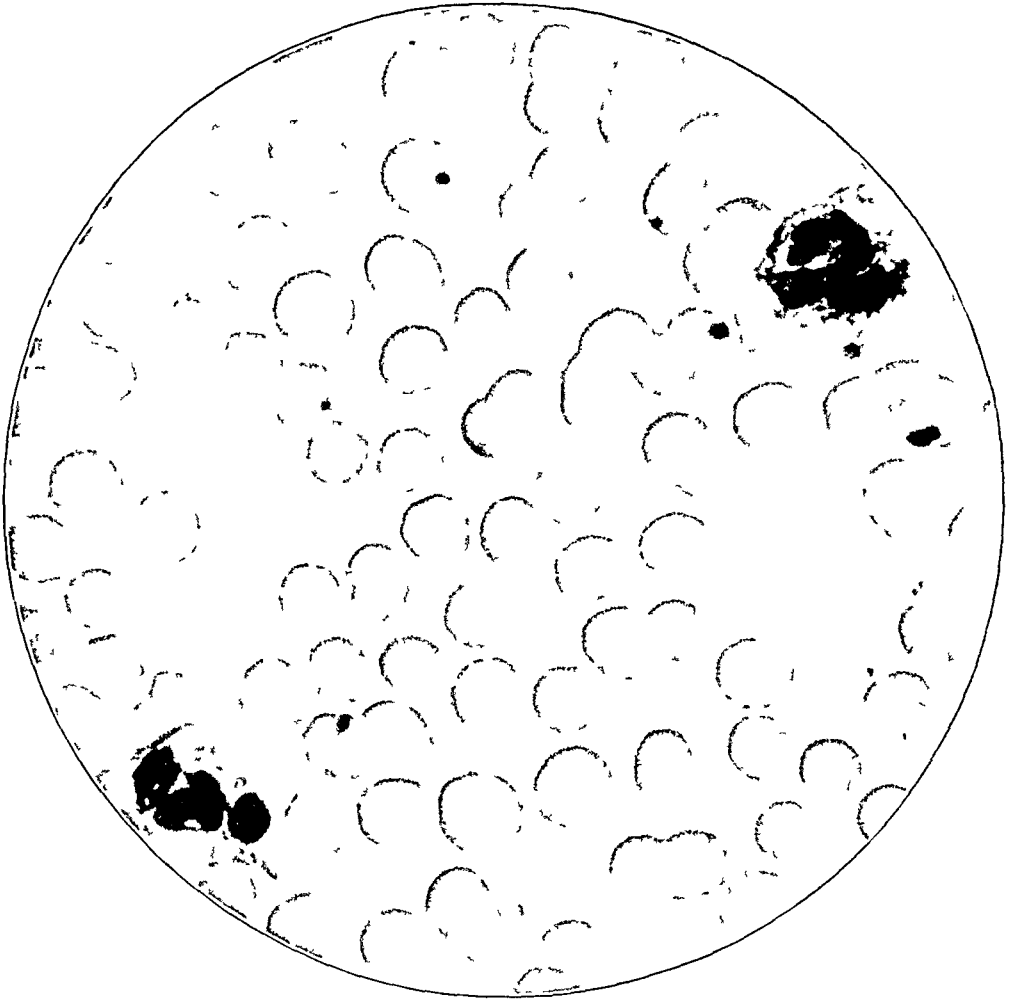


Fig 1—Normal distribution of red cells and mature neutrophilic granulocytes, the latter showing a uniform pattern of the chromatin of the nuclei and cytoplasm packed with small granules of uniform size The normal stimulus for the formation of new granulocytes to replace those lost by cell death in the circulation or in the tissues seems to be due to substances released when the nuclei disintegrate (Department of hematology, Harper Hospital)

a relatively high incidence This difference may perhaps be explained by the varying care taken in preparing the transfusion apparatus and the quality of the citrate solution employed The meticulous care

required for the successful use of the citrate method was described in detail in the paper of Lewisohn and Rosenthal⁵² Some authors found it best not to use this method in cases of extreme shock or profound states of anemia, in which conditions the extra hazard should be avoided by the use of whole unmodified blood Others have charged

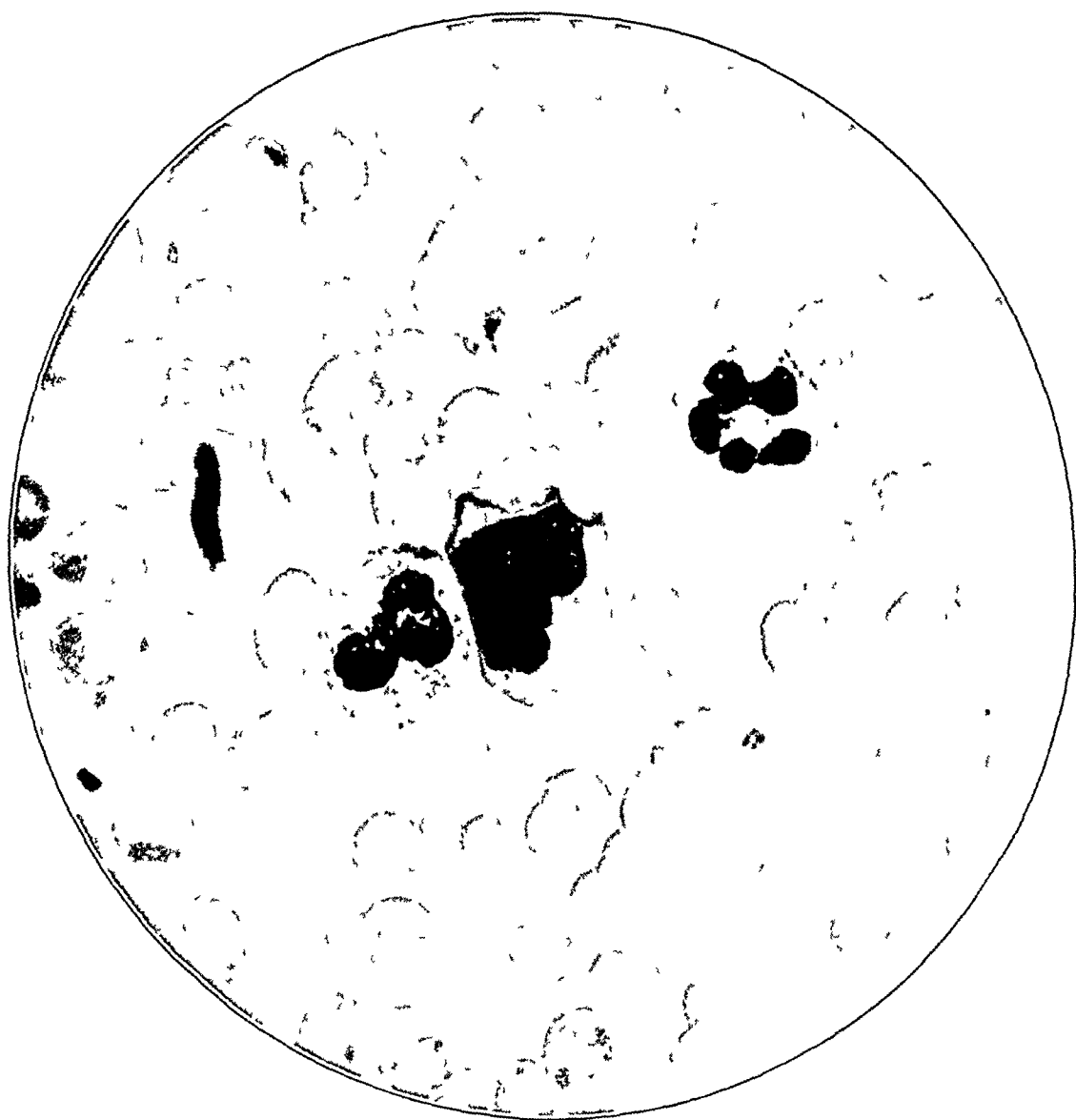


Fig 2—Hypochromic anemia in severe sepsis, hemoglobin content reduced to 36 per cent, red blood cell count, 2,800,000 One stab cell shows nuclear pyknosis (Department of hematology, Harper Hospital)

also that citrate destroys platelets, that it develops anticomplementary properties in plasma, that it reduces the phagocytic and opsonic index of the blood, that the red blood corpuscles are made more friable and

⁵² Lewisohn, R, and Rosenthal, N Prevention of Chills Following Transfusion of Citrated Blood, *J A M A* **100** 466 (Feb 18) 1933

that it produces a general systemic reaction with malaise and chills Polayes and Lederer¹⁵ reported that

Lederer, in a comparative study of a consecutive series of 100 transfusions of citrated and whole blood transfusions, encountered about 50 per cent reactions with citrated and none with whole blood transfusions

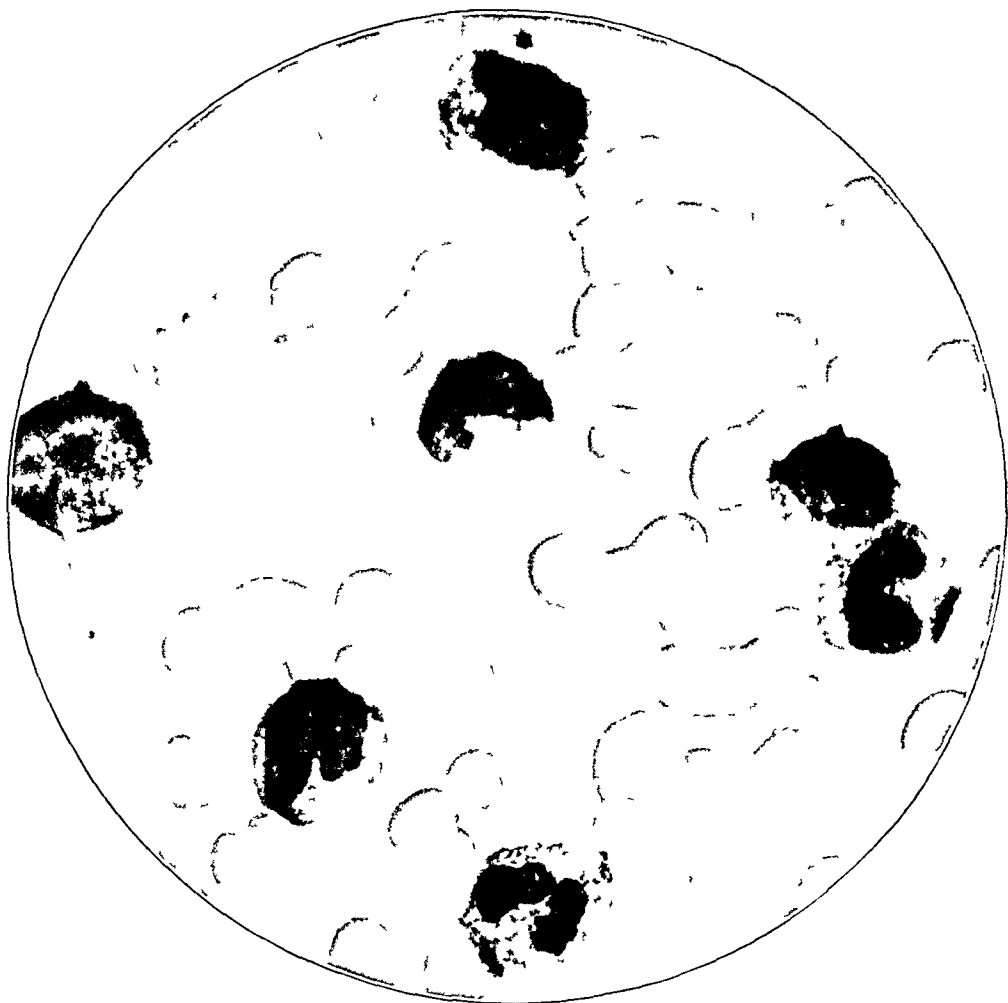
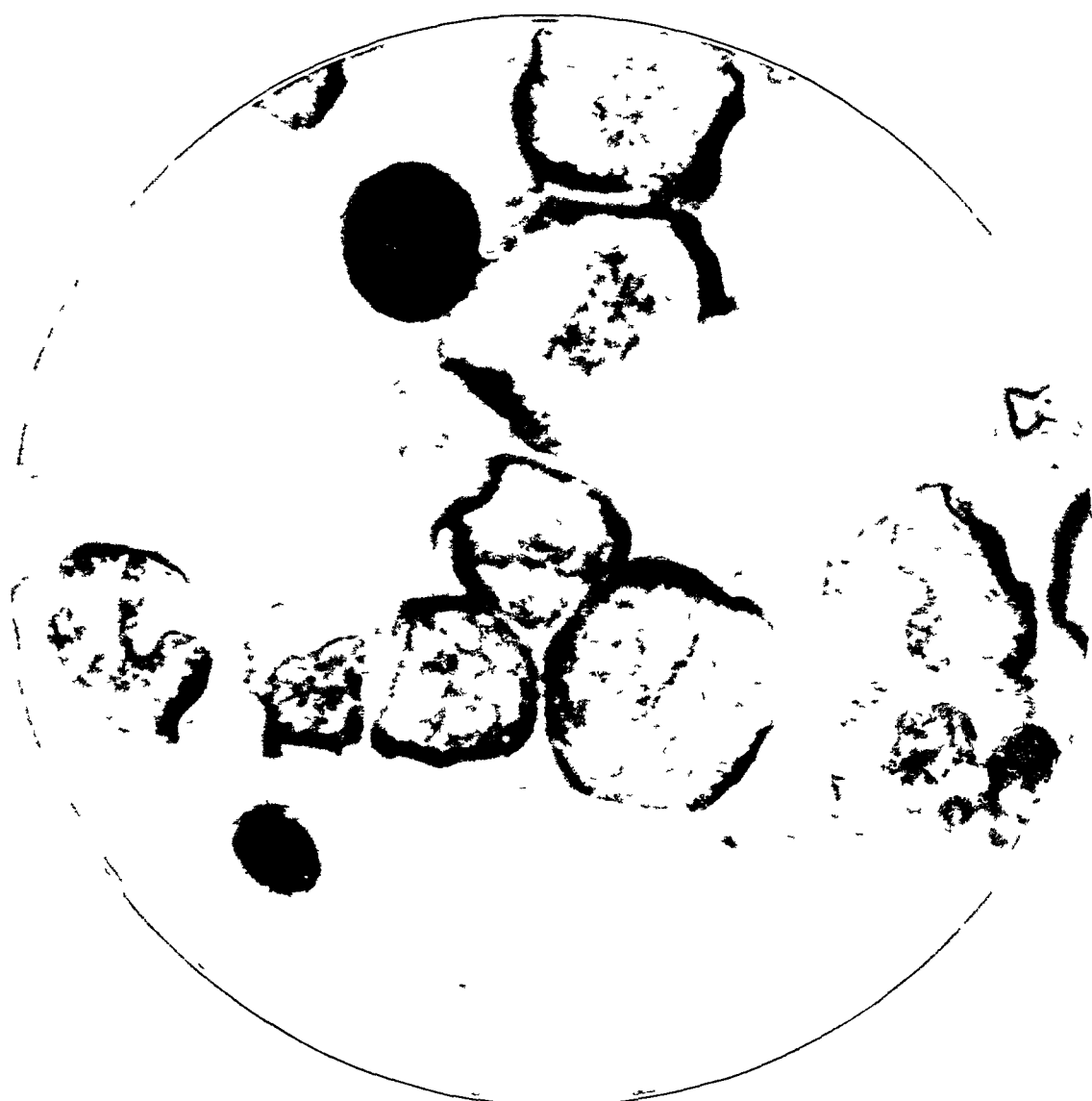


Fig 3—Peripheral blood in sepsis and toxemia, marked shift to the left, characteristic degenerative and regenerative changes, cytoplasm decreased and containing coarse "toxic" granulations, marked leukocytosis (Department of hematology, Harper Hospital)

The exact causes for these reactions are still unknown [but are believed by some to be] due to the prolonged exposure of the blood to foreign substances that the citrate method necessitates [others have concluded] that citrate produces certain chemical and biologic changes in the blood, which changes may account for the reactions. Whichever is the correct explanation,



pediatrician that their ultimate objective, the diagnosis and treatment of disease, can be attained only by their collaboration

2 By a new respect on the part of the surgeon for the benefits to be derived from efficient application of biologic and chemical therapy as supplements to the surgical drainage of infected foci

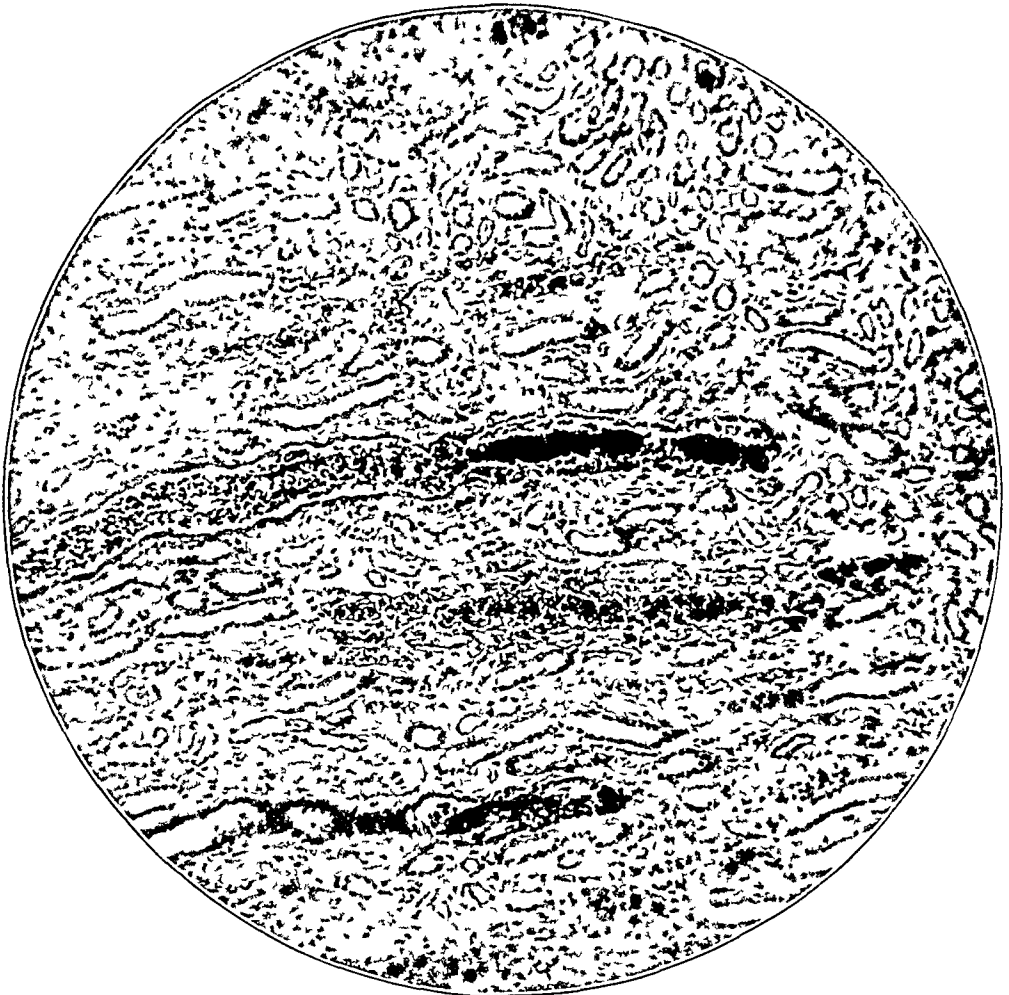
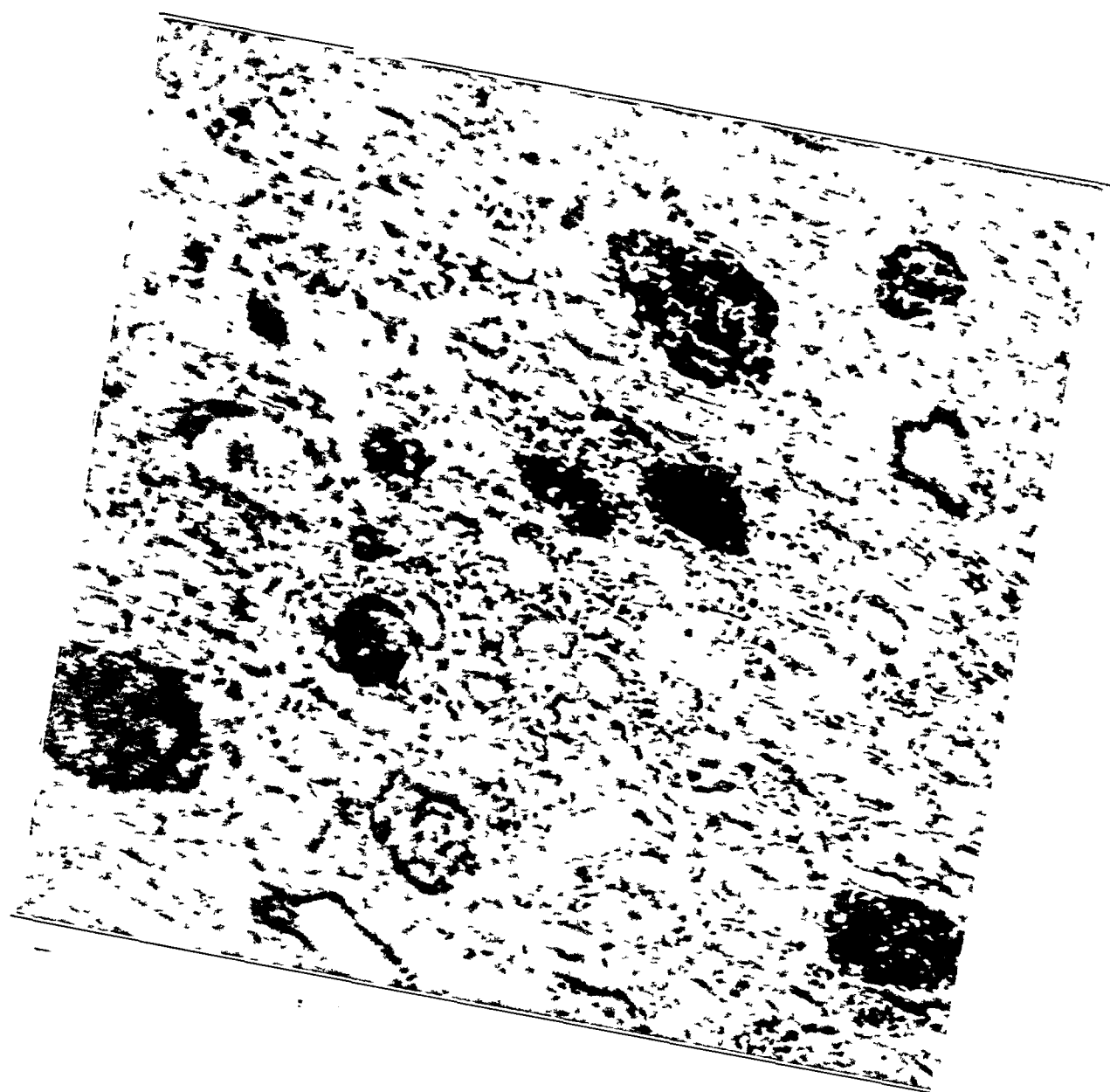


Fig 5—Transfusion death Photomicrograph of the kidney showing acute tubular hemorrhages Some of the lesions are due to the hemolysis and some to the agglutination of red corpuscles, blood pigment and disintegrated leukocytes are present (Courtesy of Dr Plinn W Morse, pathologist, Harper Hospital)

3 By recognition of the fact that statistical figures on infectious conditions must be broken up according to age groups and types and strains of the infecting organism and allowances must be made for



sepsis and the fatal renal hemorrhages resulting from the transfusion of incompatible blood, one may formulate the following conclusions:

To influence or control effectively the activities of the individual types of cells in blood and tissues, one must acquire specific information concerning their fundamental physiologic relations, not only to each other but to the other cells and functions of the body.

The effectiveness of preoperative or postoperative transfusions of blood in ameliorating or controlling the adverse activities of blood, bone marrow and parenchymal organs in otitic sepsis, is not dependent on the choice of the direct or the indirect method of intravenous injection. Their efficiency depends on their fulfilling the purpose for which they may be given: to replace erythrocytes lost in anemia, to restore the level of plasma protein, hemoglobin and oxygen carriers, to counteract leukopenia (in rare cases) and/or to increase the blood volume and water balance, thereby diluting toxic blood.

The use of immunotransfusion is different in purpose, in that its therapeutic value depends on the antibodies and other immune substances contained in the donor's blood, rather than on the blood elements themselves. Type specificity of the various strains of organisms encountered in otitic sepsis complicates the question of immunity. This is particularly evidenced in efforts to compile clinical data correlated with bacteriologic investigations of the biologic behavior and antigenic structure of the troublesome triumvirate, *Streptococcus* group A, *Pneumococcus* type III and *Staph aureus*. These efforts may culminate, in the near future, in the establishment at convenient centers of a cooperative service of direct specific biologic therapy.

Irrespective of the type of blood to be transfused or the method of its administration, the transfusion of blood should not be considered a casual routine procedure. With definite indications for its use, the value of blood therapy for otitic sepsis may be greatly enhanced by administering it at the earliest indication that it is needed and by repeating it as often as it is required while the recipient's defense forces are capable of responding and before sepsis or toxemia or both are overwhelming.

CHEMOTHERAPY

THOMAS C GALLOWAY, M D

EVANSTON, ILL

The emphasis of this symposium seems wisely placed. What happens after the primary operation usually determines whether the patient lives or dies and whether he regains a well healed ear and mastoid with normal function or has a persistent pathologic condition. It is the complications of otitis and mastoiditis that after all determine the mortality. The greatest factor in controlling these complications seems to me to be chemotherapy.

A brief general review of the use of sulfanilamide and allied compounds seems to be necessary to an understanding of the full possibilities of postoperative care. Many papers have discussed these agents, and Fenton¹ and McLaurin² covered the fundamentals before sections of the American Laryngological, Rhinological and Otological Society. Schenck³ gave an excellent summary of over two hundred and fifty titles which had appeared up to November 1938, but so much new knowledge is constantly being reported that it is difficult to keep up with the subject.

For many years efforts had been made for the chemical control of otogenic sepsis but almost without avail. Some promise had been given by substances like Pregl's iodine solution and ethylhydrocupreine given after the technic of Kolmer and Madden⁴ by intracarotid injection, but few real results were obtained. A few other chemicals, like mercurochrome given intravenously, seemed to give some help, but Mellon stated the belief that this was only protein shock therapy.

Then came the group of compounds that have brought an entirely new outlook in the fight against grave otogenic infections. They have

Read as part of the Symposium on the Care of the Patient after Operations for Sepsis of Otitic Origin at the Forty-Fifth Annual Meeting of the American Laryngological, Rhinological and Otological Society, Inc, Chicago, May 9, 1939.

1 Fenton, R. A. Sulfanilamide in Otolaryngology. *Ann. Otol., Rhin. & Laryng.* **48**: 17 (March) 1939.

2 McLaurin, J. G. Sulfanilamide in Otolaryngology. *Ann. Otol., Rhin. & Laryng.* **48**: 23 (March) 1939.

3 Schenck, H. P. Use of Sulfanilamide in Otolaryngology, *Arch. Otolaryng.* **28**: 698 (Nov.) 1938. (This is an excellent summary of the literature.)

4 Kolmer, J. A., and Madden, B. Chemotherapy and Serum Therapy of Pneumococcus and Streptococcus Meningitis. Intracarotid Treatment for Experimental Pneumococcus Meningitis. *Arch. Otolaryng.* **9**: 509 (May) 1929.

happily modified the whole prognosis for seriously ill patients and at the same time have markedly changed the practice of surgical otology. Probably this will lead, as progress usually has, to a considerable degree of technological unemployment in hard acquired skills. Compensating for this must be the great satisfaction of being able to cure disease before which one previously stood helpless. Also, new problems have been raised that will require the utmost experience and training, and, while it may not so often be employed, the same surgical judgment and facility in operative technic must still be available.

To visualize what has happened a few statistics will be cited. In 1935 at the Evanston Hospital there were 37 cases of acute mastoiditis requiring surgical intervention, with 5 deaths. In 1938 there were 5 such cases, with no deaths. In the community served by this hospital in the last two years sulfanilamide has been given increasingly at or even before the onset of otitis. In the same metropolitan area, at Cook County Hospital there was no marked decrease in the incidence of mastoiditis requiring surgical intervention, though the number of deaths was substantially reduced and 9 patients with streptococcic otitic meningitis recovered, whereas none, so far as I know, had previously recovered. The patients at this institution came from a group with little medical supervision previous to coming to the hospital, with the surgical condition in most cases well advanced. In other words, as virulent infection as usual was present in the community, but when sulfanilamide was used early and fully the control of the infection was striking.

Horan and French⁵ found the percentage of mastoiditis complicating otitis reduced from 23 to 4.5 in an English naval hospital. Though more conservatism may have been practiced because of confidence in the drugs, this controlled series seems convincing. Campbell⁶ at Ottawa General Hospital found the days in the hospital for patients with acute otitis reduced from an average of twenty-four to eight under conditions similar except for the use of sulfanilamide. In addition many more recoveries from otitic meningitis have been reported in the few years since these drugs have been used than altogether previously. At Cook County Hospital the last 5 consecutive patients with proved bacterial otogenic meningitis have recovered with chemotherapy.

Only the more definitely established facts concerning the most important chemical agents will be given here. Sulfanilamide seems to be the outstanding preparation. Much work has been done to determine its mode of action, yet there is complete agreement only on the fact that it is

5 Horan, V. G., and French, S. G. Sulfonamide in the Treatment of Acute Mastoiditis, *Brit. M. J.* **2**: 2519 (Dec. 31) 1939.

6 Campbell, G. A. Otitis Media from the Pediatrician's Viewpoint, *Canad. M. A. J.* **40**: 146 (Feb.) 1939.

bacteriostatic. When it is used *in vitro* or *in vivo*, susceptible bacteria cease to multiply—in the latter case, after a lag of several hours to allow for absorption.

This may be due to a direct toxic effect on the organism, but Whitby⁷ suggested that the effect is an alteration of the ability of the bacteria to assimilate nourishment, possibly by blocking of a receptor mechanism. Levaditi⁸ suggested that the action is due to a combination with protein of the host, especially with capsulogenous material. Locke, Main and Mellon⁹ suggested that the accumulation of peroxide, to which pneumococci and streptococci are sensitive, may explain the action of sulfanilamide. Normally this peroxide is produced by them but is decomposed by a catalase. This catalase can be inactivated by substances arising from sulfanilamide under certain conditions. Mellon stated also that organisms may be changed by these agents from a virulent mucous phase to an avirulent rough one, such change persisting for some generations, though the process may be reversible. From his experimental work, Mellon¹⁰ stated the belief that there is a marked potentiation by sulfanilamide of the immunologic effect, that is, an enhancement of the effect somewhat like synergism, by which the result is several fold the expected additive effect.

With cessation of the organisms' growth, it still remains for them to be destroyed, and the defense reactions of the body then operate normally but without the deterrent effect of bacterial toxins.

Osgood¹¹ stated the belief, based on his experiments with marrow culture, that the toxins, the agglutinins and the hemolysins are neutralized or diverted, but Long, Bliss and Feinstein¹² offered the simple explanation that in the absence of multiplying organisms the formation of toxin is negligible. Phagocytosis does not appear to be specifically stimulated, but in the absence of negative chemotaxis and toxins the leukocytes and macrophages engulf and destroy the organisms.

7 Whitby, L. Chemo-Therapy of Bacterial Infections, *Lancet* **2**:1095 (Nov 12) 1938.

8 Levaditi, C., cited by Mellon, Gross and Cooper,¹⁰ p. 227.

9 Locke, A., Main, E. R., and Mellon, R. R. Anti-Catalase and the Mechanism of Sulfanilamide Action, *Science* **88**:620 (Dec 30) 1938.

10 Mellon, R. R., in Mellon, R. R., Gross, P., and Cooper, F. B. Sulfanilamide Therapy of Bacterial Infections. Springfield, Ill., Charles C. Thomas, Publisher, 1938.

11 Osgood, E. E. Culture of Human Marrow. Studies on the Mode of Action of Sulfanilamide, *J. A. M. A.* **110** 349 (Jan 29) 1938. Osgood, E. E., and Brownlee, I. E. Mode of Action of Sulfanilamide, *ibid.* **110** 1770 (May 21) 1938.

12 Long, P. H., Bliss, E. A., and Feinstein, W. H. Mode of Action, Clinical Use and Toxic Manifestations of Sulfanilamide, *J. A. M. A.* **112**:115 (Jan 14) 1939.

in the blood, fluids or tissues where phagocytes can penetrate. The spread of the disease locally may then be sharply halted, as shown histologically by Mellon¹⁰

Locke^{12a} has emphasized that the condition of the host is an important factor and has shown in experimental animals that the presence of antibodies is necessary and that other accessories, as vitamins B₁ and C and the hormone of the adrenal cortex, are of much value. Especially must opsonins and other immune bodies be present, and if there is any doubt they must be supplied by blood transfusions or convalescent serum and in the case of the pneumococcus by type specific serums of the horse or rabbit.

Sulfanilamide is absorbed rapidly and within four hours may reach a therapeutic concentration in the blood. It also quickly reaches from 50 to 75 per cent of the same concentration in spinal fluid, exudates, transudates, empyemic fluid, pleural fluid, urine and even fetal blood.¹³ The ability to absorb and hold effective concentrations in contact with organisms in pathologic processes seems to be the factor which determines its effectiveness. Kopetzky¹⁴ expressed the opinion that bacteria invading the temporal bone may be protected from the drug. I have found persistently positive cultures provided from a walled-off area of coalescence in the tip of a mastoid otherwise healed with sulfanilamide. Lockwood¹⁵ stated the belief that peptone-like products in pus and in tissue undergoing necrosis prevent the proper effect of sulfanilamide on infections.

Sulfanilamide is most effective against the beta hemolytic streptococcus, but Hoare¹⁶ showed by experiments in vitro, along with clinical studies, that some strains of this group may be resistant, and it is a matter of common observation that not all strains respond equally well. Pneumococci are affected less by this drug and green-forming streptococci much less. *Bacillus influenzae* is moderately susceptible.

The development of strains resistant to the drug may be of some importance, as suggested by Whitby.⁷ Mellon¹⁰ expressed the opinion that this may occur and that strains which are incompletely destroyed may be changed to another phase, remain quiescent for a time and then be insusceptible to sulfanilamide. Long expressed doubt of this.

12a Locke, A, cited by Mellon,¹⁰ p. 281

13 Marshall, E. K., Jr., Emerson, K., Jr., and Cutting, W. C. Para-Aminobenzenesulfonamide. Absorption and Excretion. Method of Determination in Urine and Blood, *J. A. M. A.* **108** 953 (March 20) 1937.

14 Kopetzky, S. J. The Management and Treatment of Otogenic Meningitis, *Ann. Otol., Rhin. & Laryng.* **47** 117 (March) 1938.

15 Lockwood, J. S. Observations on the Mode of Action of Sulfanilamide and Its Application to Surgical Infections, *Ann. Surg.* **108** 801 (Nov.) 1938.

16 Hoare, E. D. Bactericidal Changes Induced in Human Blood and Serum by Sulphamido-Chrysoidine and Sulphanilamide, *Lancet* **1** 655 (March 19) 1938.

Repeatedly I have observed cases in which administration of the drug was discontinued too soon or a primary focus was not completely removed and in which the patient responded as well to a second course as to the first.

The dosage of the drug seems to have been rather well standardized. Long, Bliss and Feinstein¹² presented a table which gives the usual practice. My associates and I have usually given about $\frac{3}{4}$ of a grain (0.05 Gm) per pound (0.5 Kg) of body weight per day for three days and $\frac{1}{2}$ grain (0.03 Gm) subsequently. Slightly larger doses may be given for more virulent infection and to children, who seem to tolerate the drug better. Smaller doses suffice for less severe infections, although some observers believe the forms most virulent clinically are most susceptible to the drug. The initial doses should be large in order rapidly to reach an effective concentration in the blood, and the later doses should be distributed at four hour intervals to maintain that concentration. Covering doses of sodium bicarbonate have been advised to help to prevent acidosis.

The drug is rather rapidly excreted by the urine, and poor renal function may lead to an excessive concentration in the blood. Conversely, an excessive intake of fluids may cause too rapid elimination of the drug, though that may be desirable if toxic effects occur. Long, Bliss and Feinstein¹² advised limiting fluids to 2,500 cc per day in the average case. The dosage should be gaged by determinations of the level of sulfanilamide in the blood, and it is advised to maintain a level of between 5 and 10 mg per hundred cubic centimeters. The therapeutic effect does not always parallel the concentration, and I have seen excellent results in cases with a level of 2 mg per hundred cubic centimeters. Mellon cured one of his early patients with streptococcal meningitis with 16 grains (1.04 Gm) of the drug given over three days, and Osgood¹¹ on the basis of his experiments with marrow stated the belief that concentrations of 1:100,000 to 1:10,000 of sulfanilamide are effective. Further experience may revise ideas of dosage.

Ordinarily the drug is to be given by mouth, and nothing seems to be gained in rapidity of effect by parenteral administration. Intrathecal administration has not been shown to give added benefit. If nausea or gastric distress make oral administration impossible, sulfanilamide may be given in 0.8 per cent solution in lactate-Ringer (Hartman's) or saline solution by hypodermoclysis. In a small series my associates and I felt that we got more toxic effects this way.

Toxic effects do occur, but in most cases are not very important. Cyanosis is common and apparently without much significance, as are nausea, vomiting, dizziness, headache and confusion, and these symptoms ordinarily do not require that administration of the drug should be discontinued. Fever occurs in about 5 per cent of cases, and Long,

regarding it as a warning against graver toxic effects, advised discontinuing administration of the drug when it occurs. If the rise in temperature is of 1 or 2 degrees (F) only, that has hardly seemed necessary when the drug was badly needed. Rash is among the more serious signs. The hemoglobin content is reduced as a rule from 10 to 20 per cent as is the proportion of white cells. Severe granulocytopenia has occurred, usually without much warning, but has occurred rarely except when the drug has been given for more than sixteen days to a total amount of 30 to 60 Gm. Ten deaths have been reported from this complication, which is a small price to pay for the protection that has been given.¹⁷ Acute hemolytic anemia and jaundice are of grave importance, and usually indicate that administration of the drug should be discontinued. In acute hemolytic anemia there may be preliminary leukocytosis with a rapid fall in the hemoglobin content. Transfusions may be required if it occurs, but for serious conditions, as, for instance, meningitis, administration of the drug may even be continued, if the blood is kept toward normal by repeated transfusions. Erythrocyte and leukocyte counts and determinations of the hemoglobin content should be done every two days.

Whether one discontinues administration of sulfanilamide in the presence of toxic effects depends on their nature and their severity and on the virulence of the infection. If there is apparently the question of avoiding simple mastoidectomy or not in the presence of acute hemolytic anemia or hyperpyrexia, it seems wise to discontinue administration of the drug. If unconquered meningitis is present, administration of the drug should be kept up, complications being met as they arise.

Sulfanilamide has been discussed as the typical member of this series. Hundreds of related compounds have been investigated, and it is likely that some better drug will be evolved. At present sulfanilamide appears to be the leader by virtue of its relatively simple constitution, stability, fairly uniform action, high solubility, good absorption and rather low toxicity.

Neoprontosil, or prontosil soluble, was widely used before its chief activity was found to be probably due to freeing the sulfonamide radical in the body. This drug is inactive against streptococci in the test tube, and most investigators believe that its effect in the blood is due only to the simpler radical split from it. Domagk, who did the original work with prontosil, and Bannick, Brown and Foster,¹⁸ of the Mayo clinic, stated the belief, however, that it has some additional action and that

17 Carr, P., and Root, R. N. Granulocytopenia, *J. A. M. A.* **112** 1939 (May 13) 1939.

18 Bannick, E. G., Brown, A. E., and Foster, F. P. Therapeutic Effectiveness and Toxicity of Sulfanilamide and Several Related Compounds. Further Clinical Observations, *J. A. M. A.* **11** 770 (Aug. 27) 1938.

it is more effective than sulfanilamide and less toxic. Osgood suggested that it may be more effective with a lower concentration in the blood because of its slower breakdown with a constant, though minimal, effective dose in the blood. It is of value given intramuscularly when sulfanilamide cannot be taken by mouth and seems definitely to be tolerated in some cases in which sulfanilamide can no longer be taken.

An increasing number of reports testify to the value of sulfapyridine. It is claimed to be as efficacious against the beta hemolytic streptococcus as is sulfanilamide, though Long denied this, and has much greater effect against pneumococci, with some protection against *Streptococcus viridans*, Friedlander's bacillus, *B. influenzae*, and staphylococci. Some work indicates that it injures the protective capsule of the pneumococcus.⁷ This drug is less soluble and has a varying rate of absorption, with some variation in the clinical effects. Whitby⁷ stated the belief that it is less toxic than sulfanilamide, but Long¹⁹ explained the diminished toxicity on the basis of lower solubility and poorer absorption and maintained that it has no advantage when the amount actually absorbed is taken into consideration. Marshall, Bratton and Litchfield²⁰ found the soluble sodium salt quite as toxic as sulfanilamide. My patients have seemed to find sulfapyridine nauseating, and gastric distress and mental depression have seriously lowered morale in a number of cases.

Some special questions require discussion. Among these are the following: How do these drugs modify pathologic conditions? How do they modify symptoms? When is surgical intervention or additional surgical intervention needed with them? Do all foci need drainage or removal?

The modification of pathologic conditions depends on the vulnerability and the accessibility to the drug of the infecting organism and the time of administration. Mellon showed that in inoculated foci in experimental animals the spread of disease may quickly be arrested by administration of sulfanilamide, with rapid healing. From my experience with operations on the mastoid when sulfanilamide had been thought to have failed, I think that complete recovery can take place in spite of extensive involvement. For obvious reasons this statement must not be interpreted as advising expectant treatment in such cases. In cases of mastoiditis in which the drug has been given fairly early, at operation one is likely to find a spotty pathologic condition. Areas of nearly normal hard bone may alternate with zones where the bone is soft and areas of

19 Long, P. H. Sulfapyridine, *J. A. M. A.* **112** 538 (Feb. 11) 1939.

20 Marshall, E. K., Jr., Bratton, A. C., and Litchfield, J. T., Jr. The Toxicity and Absorption of 2-Sulfanilamidopyridine and Its Soluble Sodium Salt, *Science* **88** 597 (Dec. 23) 1938.

previous breaking down may be filled with granulations varying from soft to firm, organizing ones, with some cells even containing pus, with or without culturable organisms. In a mastoid operated on in the fifth week, chiefly on account of pain, there had been extensive destruction, yet no pus was found, culture was negative and granulations were everywhere firm and fibrous. This, I think, would have completely healed without intervention. In another case the patient had had stormy serous labyrinthitis and elevation of temperature to 99.5 F persisting in the fifth week, with a moderate discharge showing numerous colonies of hemolytic streptococcus even after full doses of sulfanilamide. At operation a cavity 1.5 cm wide in the tip was found filled with pus. This might, I think, have continued almost indefinitely. A section from a mastoid of a patient for whom administration of sulfanilamide had to be stopped on account of acute hemolytic anemia showed considerable definite formation of new bone with a matrix, osteoblasts and recent calcification.

Mellon and Whitby⁷ expressed the opinion that these agents do not modify the immune reactions, Long²¹ stated the belief that they may. It seems that if the compounds are given early there may be not enough general and local damage to provoke the reactions of immunity. Some observers²² have noted that when convalescent serum and sulfanilamide were used early for scarlet fever, the Dick reaction remained positive after recovery. It has seemed to me that in a few cases in which the drug was given early and administration then had to be stopped on account of toxic effects, the patient progressed as one who only then began to develop local and general immunity—that is, that the age of the disease was dated approximately from the time when administration of the drug was discontinued.

It is important to know how symptoms can be modified by these drugs, because modified criteria of diagnosis must be established if administration of the drug is to be continued for its best effect when complications are imminent and not discontinued, as seems too commonly done, for fear of masking symptoms. Symptoms of sepsis may be either simulated or suppressed.

Simulated symptoms due to the drugs may be fever, with which the temperature may vary from $\frac{1}{2}$ to 4 degrees (F) above normal and which may require that administration of the drug should be stopped at least temporarily for clarification, although lack of leukocytosis is an important differentiation, nausea and vomiting, which according to the belief stated by Long are due to central irritation, cyanosis and depression, which might be taken for the appearance of sepsis but usually

21 Long, P. H. Sulfapyridine, *J. A. M. A.* **112** 1850 (May 6) 1939.

22 Sauer, L. W. Personal communication to the author.

can be recognized as quite different, headache and neuritic pains, which in several cases were quite like those of meningeal irritation, and depression and confusion, which are not always easy to distinguish from toxic cerebral depression or encephalitis (chart 2)

Suppression of symptoms probably occurs only because the activity of the organisms is inhibited. Long, for instance, showed that sulfanilamide had no antipyretic effect in typhoid fever. As an example of

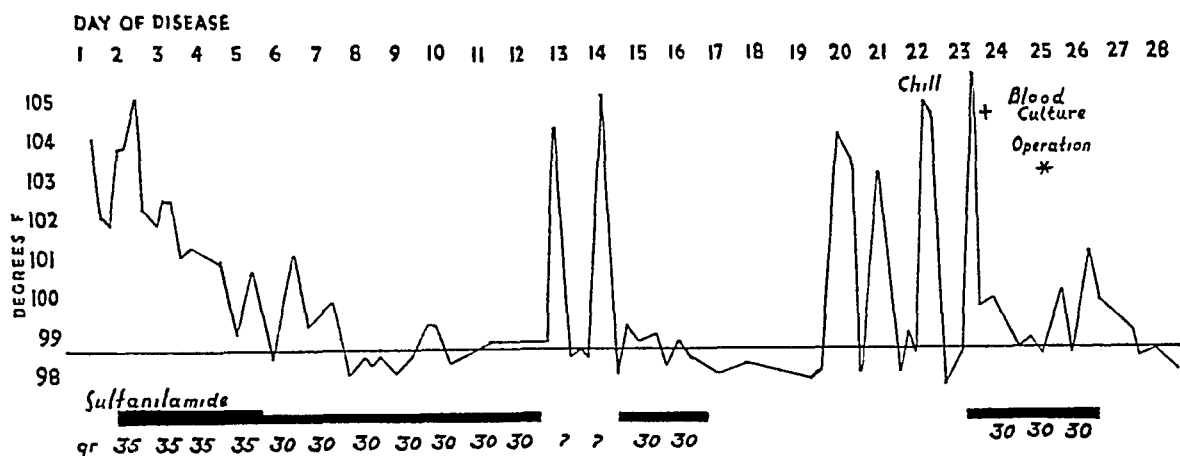


Chart 1—Masked sinus thrombosis. At the point designated ? ? the patient vomited and little or none of the drug was absorbed. At operation the sigmoid sinus was found filled with a septic clot.

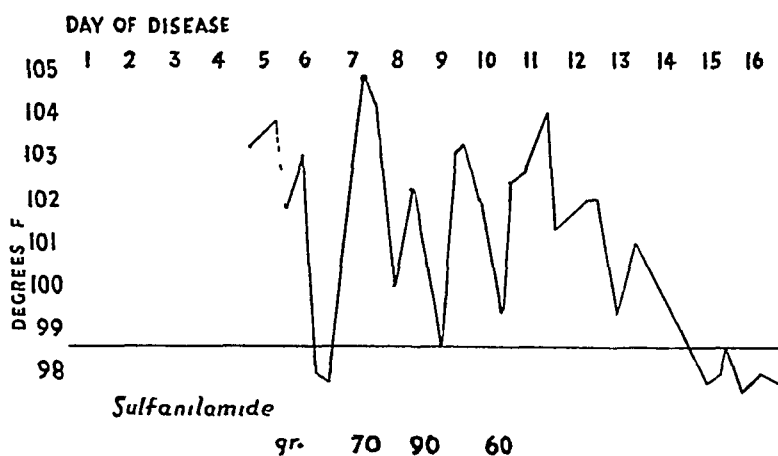


Chart 2—Simulated encephalitis. The patient had hyperpyrexia, severe headache, nystagmus and asynergy and was disoriented. The picture suggested encephalitis but cleared within forty-eight hours after the administration of sulfanilamide was stopped.

suppressing grave sepsis, the steeple temperature curve in a case of sinus thrombosis twice flattened to normal when sulfanilamide was given, although at operation the sinus was found filled with a septic clot (chart 1)

The diagnosis of complications in the presence of chemotherapy may be difficult, but with experience with these agents it has seemed that seldom in the individual case is one unable to ascribe to the drug and to the disease their proper places. If in spite of adequate dosage of the drug important symptoms persist, the need of intervention is still greater than when symptoms are present without the drug, and operative indications must be modified accordingly.

The question of the masking effect seems to be handled quite differently by various authors by whom it has been discussed. Statistical evidence already quoted seems to me to support the opinion that for all threatening otitis the drugs should be given, and, whether otologists agree or not, the pediatricians seem to have decided the question this way. To withhold it at the threatening stage for fear of masking the disease appears no more logical than for a fireman to turn off his hose to see what a fire is going to do. On the other hand, many authors believe that if sulfanilamide is to be effective, results will be definite in from three to five days or perhaps seven. If no serious trouble develops and if it appears to have some favorable effect, administration of sulfanilamide should probably be continued still longer. If then the clinical picture is not clear and the condition still not serious, administration of the drug should be discontinued in order to show the true manifestations of the disease. Fever is most likely to complicate the picture, and for patients otherwise doing well it is usually safe to stop administration of the drug and postpone operation for two days to be sure the chemical is not responsible. Likewise if active disease seems to be cured, especially a deep process, it is generally advised to continue administration of the drug for four to six days more and to observe the patient closely for some time thereafter. Lockwood¹⁵ and others have shown that pocketed processes may be apparently inactive but recrudesce after the drug is eliminated.

It is obvious that the classic indications for operation should hold if the condition is seen fully developed or if it is necessary to discontinue administration of the drug on account of its toxic effects. When the drug has not been given, it is usually safe in the absence of the more serious complications to administer it and wait, as spread of the process is then less likely. I have seen surprising recoveries occur in cases of marked tenderness, swelling, roentgen evidence of softening of the bone and even subperiosteal abscess.

There will also be less necessity for early intervention even in the virulent infections with hemolytic streptococci, as these seem to be the organisms most vulnerable to sulfanilamide. Even the threat of complications probably should not hasten intervention within the first week of onset, as such infections have repeatedly been controlled by the

drug In a case previously reported from Cook County Hospital, hemolytic streptococcic meningitis developed five days after the onset of acute otitis Discharge from the ear was hemorrhagic and profuse At the suggestion of Dr S J Pearlman, operation was not done, since presumably the path of infection was through vascular channels The meningitis speedily cleared under sulfanilamide therapy The ear stopped discharging, and operation was not necessary In a second case of meningitis on the sixth day of otitis similar treatment brought about recovery Such examples, however, should not lead to failure to remove all active foci

Also the nature of the operative intervention may be changed when it is apparent that sulfanilamide is controlling infection One may be more conservative, as suggested by Kopetzky, in discussing a case of acute labyrinthitis in which he found it unnecessary to open the labyrinth Some surgeons may have less respect for the dural barrier, though that may prove deplorable, but a certain protection may be afforded when it appears necessary to open the dura

That all diagnosed foci of active disease should be removed or drained, even when the infection is apparently controlled by the drug, seems generally agreed It seems much wiser, at least with the more serious complication of meningitis, sinus thrombosis or abscess of the brain to leave no possible active focus which is amenable to reasonable surgical intervention

Meningitis if due to the hemolytic streptococcus seems to be well treated by the usual administration of the drug, with spinal drainage as indicated by the symptoms In reporting 6 recoveries from pneumococcic meningitis, Finland, Brown and Raub²⁴ seemed to have an improved technic Sulfanilamide was given in full doses by mouth and then type specific serum by vein After two hours, blood was withdrawn, the serum separated and 5 to 10 cc of this serum given intraspinally in order to supply the complement, which is lacking in the spinal fluid Rhoads, Horswell and Fox²⁵ were unable to duplicate this success with the same method, but had 5 recoveries in 17 cases with the combined use of serum and sulfanilamide

Overenthusiasm for the drugs has already led to some disasters They cannot replace training, knowledge and care in medical practice, and their limitations must constantly be borne in mind There are numerous reasons why they may fail

²⁴ Finland, M, Brown, J W, and Raub, A E Treatment of Pneumococcic Meningitis, *New England J Med* **218** 1033 (June 23) 1928

²⁵ Rhoads, P S, Horswell, R, and Fox, W Treatment of Pneumococcic Meningitis with Specific Antipneumococcic Serum Plus Sulfanilamide or Sulfapyridine, to be published

Certain organisms, as the staphylococcus and *Str viridans*, seem hardly at all susceptible to them. The presence of these organisms in mixed culture apparently prevents the full effect of the drug on susceptible organisms. Also resistant strains of ordinarily vulnerable bacteria may occur. Hoare, for instance, found little clinical response to sulfanilamide in some cases of puerperal sepsis due to hemolytic streptococci and demonstrated in the laboratory that these strains were refractory.

Protected foci, or dead spaces to which drugs do not penetrate, were postulated by Ballenger, Elder, McDonald and Coleman,²⁶ Kopetzky¹⁴ and others as a cause of failure. One sees such pockets not infrequently in an otherwise healed mastoid. Lockwood¹⁵ found that peptone and peptone-like bodies rendered sulfanilamide relatively ineffective and stated the belief that their presence in pus or tissue undergoing necrosis explains some failures.

Other causes of failure reside, as Mellon¹⁰ and his co-workers showed, in general factors pertaining to the host. Lack of opsonins, of the complement and of other immune bodies, anemia, lack of phagocytes, chilling, general debility, deficiency of vitamins and other factors can prevent cure in spite of the bacteriostatic effects of the drug.

Toxic effects also may prevent realizing the beneficial effects of the drugs. Improper administration is an important reason for failure. Infrequent spacing may allow the concentration, especially of the more soluble drug, sulfanilamide, to fall below the effective level. Osgood stated the belief that the maintenance of this minimal level is most important. Failure to retain or absorb the drugs is frequently overlooked, as it would not be if frequent determinations of the level in the blood were made, and the vomiting of the drugs before absorption also is not always taken into account. If cultures are not taken, a non-susceptible organism may be futilely treated. Alertness for possible serious complications can easily fail and proper consultation not be sought until too late, especially if there is overconfidence in the drugs. Herein lies grave danger.

On the basis of the foregoing observations, certain principles may be formulated for postoperative chemotherapy as a ground for further discussion. Treatment in each case must, of course, be individualized.

If chemotherapy has not been administered before operation and the patient presents fully developed indications for intervention, with a presumably susceptible organism, it seems that the drug should be given

26 Ballenger, E. G., Elder, O. F., McDonald, H. P., and Coleman, R. C., Jr. Failures in the Treatment of Urinary Tract Infections with Sulfanilamide, *J. A. M. A.* **112** 1569 (April 22) 1939.

to shorten convalescence, safeguard against complications and diminish mortality. Masking of more serious trouble should be borne in mind.

If in spite of presumably adequate chemotherapy operation becomes necessary, further administration of a drug is not needed if the disease is removed or the area satisfactorily drained. Usually, however, the drugs will have had some effect, and failure may have been due to too late or improper administration, so that, if further trouble threatens, the drugs still seem desirable if they are well borne.

If toxic symptoms occur, especially the more severe ones, and surgical intervention seems sufficient, administration of the chemicals is stopped. If meningitis develops, probably administration of the agents will have to be continued, bad effects being met as they arise, and all possible adjuncts being used, including serums and blood transfusions. This conviction has grown out of an experience of complete failure before the use of sulfanilamide and its allies.

Sinus thrombosis can probably be dealt with successfully without the drugs if necessary. But here also the chemicals seem to hasten cure and prevent the danger of local and general spread of sepsis.

With petrositis, when one may not be sure that drainage and unblocking are sufficient, sulfanilamide might be withheld for further study of the case, unless there are signs of meningeal involvement or complete operative removal seems impracticable. I should try a drug before sacrificing the middle ear.

If one can consider labyrinthitis without entering into too much controversy, it seems proper, as Kopetzky has reported, to be more conservative, placing considerable reliance on the drug. Especially may one do so if one follows Alexander's dictum, to watch such a condition hour by hour and intervene only when there is definite sign of meningeal irritation. Recently 2 patients with acute diffuse suppurative labyrinthitis recovered with sulfanilamide, 1 without mastoidectomy.

Abscess of the brain should be treated surgically of course, but chemotherapy, unless it has produced severe toxicity, should be used to give additional protection against spread of infection or secondary meningitis.

DISCUSSION OF PAPERS IN SYMPOSIUM

DR. SAMUEL KOPETZKY, New York. I have always been in favor of transfusions and have used small ones repeated at two or three day intervals extensively. The minute one has mastered the sepsis in a particular case, the patient holds the hemoglobin after transfusion. I think sulfanilamide is the most valuable drug one has when one is faced with a grave situation. I do not think one should misuse it in the early stages. One sterilizes the blood and other fluids of the body, but the pressure on the nutrient veins of the intracellular walls of the

mastoid process is unaffected, and the lesion proceeds. Hence, this year many patients have come into the hospital with lesions such as epidural abscesses, which they should not have when treated by competent physicians, and they came because sulfanilamide was used in the early stages of the otitic infection and masked the progress of the pressure that produced the lesions. The misuses of sulfanilamide have not been sufficiently stressed, in my opinion. A patient receiving sulfanilamide should be kept out of direct sunlight. Most of the bad complications have been among Negroes in New York. Babies, also, must not be given large doses of sulfanilamide.

An easy means of holding the concentration is the rectal administration of sulfanilamide, which has not been mentioned. By means of a suppository put in the rectum one can hold the concentration steady for a longer time, and one can watch the result by testing for the concentration. At the least sign of discomfort, an enema removes it.

Sulfanilamide, plus transfusions, which replace materials used in the chemical combinations, leaves the body in better condition than ever. One should never stop the administration of the drug suddenly but should taper it off.

DR JOHN MACKENZIE BROWN, Los Angeles. In conjunction with sulfanilamide my associates and I have been giving 50 to 100 cc of antiscarlatinal serum every second day. There have been no ill results except slight urticaria.

DR WILLIAM L. CULBERT, New York. The first point I wish to make is the introduction of the duodenal tube into the stomach through the nose, for either occasional feedings or frequent small feedings, or even for feeding by the drop method used now in the treatment of gastric and duodenal ulcers. The second point is prolonged oxygen therapy, a powerful factor in the treatment of a toxic patient. The third is the use of leukocytic extract, which I have found of great value when the leukocytic battle was going against the patient.

DR JOHN G. McLAURIN, Dallas, Texas. My own experience is that few mastoidectomies are performed in my section, I believe because the physicians there generally are using sulfanilamide early. Many patients with acute infection of the upper respiratory tract or infection associated with otitis media have at first shown definite leukopenia. To my mind, it is indicative of a profound infection that has so affected the hemopoietic system that leukocytosis has not occurred. It shows lowered resistance. In such cases the use of sulfanilamide has almost invariably increased the leukocyte count. Another point brought out that I rather disagree with is that babies and young children do not tolerate the drug well. I find as a rule that a concentration of 4 to 5 mg is sufficient to take care of the average infection of the upper part of the respiratory tract. Finally, one is given to believe that fever produced by sulfanilamide will usually disappear in forty-eight hours after administration of the drug has been discontinued. I have in some cases seen fever continue for two or three weeks.

DR FREDERICK M. LAW, New York. After administration of sulfanilamide the roentgen appearance of the mastoid indicates that the condition is not as severe as the clinical evidence suggests. The drug does something to the contents of the cells whereby they are made more translucent to the roentgen ray, so much so that in cases in which the severity indicates operative intervention one cannot tell from a single film which side is involved. The opacity is practically gone.

The only change noted is in the appearance of the cellular structure. In the mastoid which begins to break down, the cells appear to be thin as compared with those on the other side. Stereoscopic films in the same case show the beginning of the osseous change, it may be faint, affecting a few cells only, or it may be extensive. Whenever one gives sulfanilamide one should notify the roentgenologist to that effect, and let him correct his interpretation. If a single film is made, the roentgenologist depends on the degree of opacity or on the appearance of a considerable area of coalescence. With stereoscopic films, one can see the

deeper cells, the ones in the floor of the mastoid, extending toward the antrum, are not there, or the cortical cells are present. On the single film one cannot see them.

It is apparent that if sulfanilamide is given before osseous change occurs resolution will take place. If it is given after osseous change has started the process continues, as subsequent films will indicate.

DR THOMAS C GALLOWAY, Evanston, Ill. Many authors believe that sulfanilamide, to be effective, must produce definite results in from three to five days or, perhaps, seven. If no serious trouble develops, and if it appears to have some favorable effect, sulfanilamide should probably still be given. If then the clinical picture is not clear, and the condition still not serious, the use of the drug should be discontinued in order to show the true manifestations of the disease. Fever is most likely to complicate the picture. If the patient is otherwise doing well, it is usually safe to stop giving the drug and postpone the operation for two days to be sure the chemical is not responsible. Likewise, if an active disease seems to be cured, especially a deep process, it is generally advisable to give the drug from four to six days more, in the hospital of course, and to observe the patient closely thereafter for some time.

A SIMPLE QUANTITATIVE METHOD OF TESTING VESTIBULAR FUNCTION

MILES ATKINSON, M.D., F.R.C.S. (Eng.)

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Information regarding the functional activity of the eighth cranial nerve and its end organs is often required both for otologic and for neurologic diagnosis. In the case of the cochlear division this information is easily obtained, since the application of tuning fork tests is simple and their significance is generally known. Moreover, by means of the audiometer a graphic record can be obtained which is always available for comparison and which can be universally read and appreciated. With the vestibular division the case is very different. While all otologists are familiar with the principles of the Barany tests of vestibular function, there is a remarkable lack of unanimity as to their value and the precise method of their application. Some rely chiefly on the turning test, others, on the cold caloric. In the performance of the latter, there are almost as many variations as there are testers. Out of such chaos accurate knowledge cannot come. What is urgently needed is a standard method which will serve as adequately and as simply for appraising vestibular function as Rinne's test does for appraising cochlear

THE CONDITIONS

Such a test, to be of real value, must fulfil certain conditions

- 1 It must be simple—applicable as well by junior interns as by heads of departments
- 2 It must be time saving, not time consuming—Kobrak's quantitative method and others like it, admirable as they may be for the physiologic laboratory, are too cumbersome for the clinic
- 3 It must test each vestibule separately—wherefore rotation, which stimulates both simultaneously though in different degrees, is unsatisfactory
- 4 It must use a minimal adequate stimulus—one does not test the sense of touch with a hammer or of temperature with a red hot poker
- 5 It must be quantitative—to allow of accurate comparison between ears
- 6 Its results must be capable of simple expression so that they can be universally comprehended

From the Department of Otolaryngology, New York Hospital and Cornell University Medical School

THE METHOD

It is realized that it is impossible to devise a thermal test of absolute accuracy because the heat is conducted to the labyrinth by way of bone, and therein is considerable anatomic variation. Nevertheless, the cold caloric test performed in the manner to be described approximates as closely as possible to absolute accuracy, especially when it is remembered that what is being compared is always the two ears of the same patient, in whom anatomic characteristics are likely to be the same on both sides, and not two patients. In practice it has been found to be satisfactory, and it conforms with the requirements laid down.

The general principle of the method is that 1 cc of ice-cold water is injected into the ear and the time of onset of nystagmus is noted. The ear is then emptied, and the time of duration of the nystagmus is also noted. These times bear a definite relation to each other under normal conditions, as will be explained later.

DETAILS

There are certain details which must be observed with some care if accurate and satisfactory results are to be obtained.

1 The position of the head is important. Ideally it should be in such a position that the external semicircular canal is in the *vertical* plane with the ampulla as the highest point. This is achieved as nearly as possible by leaning the head over to the horizontal so that one ear is above the other (the body has to lean over as well) and tilting the chin upward through 45 degrees by rotating the neck. The position sounds a forced and uncomfortable one, but actually it is not.¹

2 The syringe used is of a special type. It has a setscrew on the plunger so arranged that only 1 cc of the 10 cc which the syringe contains when filled is delivered when the plunger is pressed down. By this means the inevitable change in temperature of the water in the syringe during transport from bowl to patient is minimized, the rise in temperature of the larger bulk of water (10 cc) being infinitesimal, while that of 1 cc only might be large.

3 The actual procedure is as follows. Ten cubic centimeters of water in which ice is floating—*ice* water, not *iced* water—is drawn into the syringe, which has lain immersed in the ice and water for some minutes. With the head in the position described so that the ear to be tested is uppermost, 1 cc of the ice water is instilled into the external auditory canal, and the time of instillation is noted by stopwatch. The

¹ Prof. Gusta Dohlman, of Lund University in Sweden, elaborated this position with me and suggested the large syringe.

patient is then made to direct the eyes on a finger held on the side opposite to the ear being tested, and the eyes are watched hawklike for the first flicker of nystagmus. This requires some practice to detect without use of artifice, but if the patient wears a pair of spectacles fitted with 20 D lenses or the observer uses an ophthalmoscope, the onset of the nystagmus is more readily appreciated. This moment is noted on the watch. The interval which has elapsed between instillation and nystagmus is the *time of onset*.

At once the ear is emptied of water. The patient is tested for nystagmus, first with the head forward 30 degrees and then with it back 60 degrees to test all canals, and for pointing error, a matter of thirty seconds or so. He is then watched, again with great care, for the end point, when nystagmus stops, the time is taken again, and the second interval of time, from start of nystagmus to finish, is the *time of duration*. Finally the subjective reaction is noted, whether none, slight, moderate or severe.

The other ear is tested in the same manner after two or three minutes have elapsed, to insure the cessation of all dizziness.

4. If there is no reaction to stimulation in three minutes, the labyrinth is probably dead, but to make certain of this the test is repeated immediately for three more minutes. If still there is no reaction, the labyrinth can be pronounced dead with certainty.

5. Because patients are fearful of an unknown procedure they should be told before starting what is going to be done and that nothing more than a transient dizziness need be expected. It is also wise to test first that ear which is expected to be normal or the more nearly so, lest the other be hyperactive and the patient be disturbed and frightened by a severe reaction. By this method it is rare, however, for any serious discomfort to be felt, even with a hyperactive labyrinth, and vomiting is unknown.

CHARTING THE RESULTS

The results are represented as a simple fraction, the time of onset over the time of duration in seconds. A record is also made of the type and quality of the reactions obtained. The following example is from the case record of a patient with Meniere's disease.

Nystagmus	Time of Onset Time of duration (sec.)	Right	Left
		25 90	15 120
Reactions			
Nystagmus	{ Head forward 30° Head back 60°	To left To left	To right To right (great discomfort)
Pointing error		To right	To left (marked)
Subjective reaction		Moderate	Severe with nausea
Opinion	Hypersensitive left labyrinth		

READING THE RESULTS

It has been found that in the normal labyrinth tested in this way the average time of onset of nystagmus is about thirty seconds but that individual variations occur, so that responses varying from fifteen seconds as a minimum to sixty seconds as a maximum lie within the limits of normality

More important than the actual time of onset, however, is the relation of this to the time of duration. Duration is normally about four times as long as onset. A very usual finding is 25/90, that for the right ear in the example given. If the time of onset is fifteen seconds, the low limit of normal, and that of duration no more than sixty seconds without undue subjective reaction, the reading can be considered within normal limits, but if with an onset of fifteen seconds the duration is prolonged much beyond sixty seconds, and pointing error is pronounced and subjective reaction considerable, as with the left ear in the example, the labyrinth is markedly hypersensitive. Similarly, if time of duration approximates to or is less than time of onset, particularly if the latter is sixty seconds or more, the function of the labyrinth is depressed. The relation of the two times, more than the times themselves, is the fact that matters

For example	(1)		Right	Left	or (2)	Right	Left
		Onset	60	60		15	15
		Duration	200	200		60	60

indicates normal labyrinths. Though the responses are slow in (1) and fast in (2) they are in each case equal on the two sides and within normal limits

But if the figures on the left side are reversed, thus

(3)			Right	Left	or (4)	Right	Left
		Onset	60	200		15	60
		Duration	200	60		60	15

the reading indicates a markedly hypoactive left labyrinth. On the left side the relation of the times is wrong, and the reactions of the two sides are grossly unequal

It is evident that by this means a factual report can be given of the function of the vestibule, a report which is as definite and accurate as an audiogram for the function of the cochlea. Moreover, a second observer, the neurologist for instance who receives the report from his otologist colleague, is not compelled to rely solely on the expressed opinion of the latter, but has before him the facts on which that opinion was based. Given a knowledge of the normal, which should be printed on each report sheet, he is in a position to check the other and form his own opinion. The argument applies with even greater force to published case reports

Too often one finds such vague generalities as that "the labyrinth did not react to syringing with cold water," or reads with misgiving that with a hearing ear "the labyrinth was dead." Use of this method allows the observed facts to be given in small compass and facilitates the passage of accurate information. It would be of advantage to everybody if the cold caloric test could be standardized along these lines.

THE ROTATION TEST

But, it will be asked, what of the rotation test? Is that to be no more used? The answer is that compared with the cold caloric the rotation test is of little value. Rotation is a physiologic experiment, and as such has done yeoman service in helping to elucidate the problems of the labyrinth. As a clinical test of labyrinth function it fails because it stimulates both sides simultaneously, even if unequally, and because it is extremely difficult so to regulate the stimulus that it shall be minimal—the usual method produces a stimulus more nearly maximal. It still has a clinical purpose to serve, however, in differentiating between peripheral and central lesions. When the reactions to the cold caloric test are equivocal, the rotation test may help to elucidate their meaning, but the larger the experience with the cold caloric test the less frequently will rotation be found necessary.

CONCLUSION

The method which has been described of performing the cold caloric test has various advantages.

- 1 A known amount of water of known temperature, a temperature, moreover, easily achieved and easily kept constant, is allowed to act for the least time necessary to produce a reaction—thus it is quantitative. The rise of temperature which must take place in the water by contact with the body does not affect the quantitative character of the test, since the change is the same on the two sides, and it is two sides of the same patient which are being compared, not two patients.

- 2 The reaction is such that the end points are definite and their appearance can be timed—thus it is accurate, or at least as accurate as the eye of the observer, a proviso for human fallibility which has to be applied to all tests.

- 3 There is in normal ears a practically constant relation between time of onset and time of duration, 1/4—thus it is mathematical in the basis it provides for comparison.

- 4 The stimulus applied is minimal—thus the reaction of the patient is also minimal. Patients who have been tested by other and more

diastic methods are unanimous in their approval of this one and have no dread of it a second time

5 The test is simple to perform, takes little time and fulfils all the conditions laid down at the beginning—thus it is practical Its value in this respect and its accuracy have been amply proved by experience

SUMMARY

The necessity for some standardization in the tests of vestibular function must be apparent to all clinicians who have to apply them and to all who have to peruse the written record of their results The method described is simple, accurate, practical and easily recorded Its value and accuracy have been attested by several clinics where it has been adopted as the routine method It is suggested that its general adoption as the standard vestibular test would make for all-round simplicity

123 East Sixty-First Street

STRUCTURE OF THE PETROUS PORTION OF THE TEMPORAL BONE

WITH SPECIAL REFERENCE TO THE TISSUES IN
THE FISSULAR REGION

BARRY J ANSON, PH D (MFD Sc)

AND

J GORDON WILSON, MD

CHICAGO

To the morphologist the petrous portion of the temporal bone presents several interesting features. It contains a bony case built in a unique manner to shelter the delicate terminals of the auditory and vestibular mechanism, this case is constructed from separate centers of ossification which ultimately blend so completely that there appears, at birth, a composite capsule with no line to indicate the originally separate entities. The capsule thus formed does not enlarge after birth but increment is made in the petrous portion of the temporal bone in which the capsule is embedded. Even after adult size has been attained histologic changes in the otic capsule continue throughout life, the site of the most striking postnatal alteration is the small area between the cochlea and the stapes, in the wall of the capsule, in this territory of the fissula ante fenestram the capsule retains nonosseous tissues (connective tissue and hyaline cartilage) to a degree not usually observed in adult "bones", here also occur unusual forms of osseous tissue (intra-chondrial and sclerotic bone).

To the histologist the organization of the petrous portion appears so different from that of any other bone in the body that he inevitably asks why in this region nature has transgressed the general rules governing the building of the bony skeleton, further, he is impelled to search for the basis of pathologic change in the structural peculiarities of the otic capsule.

An enlargement of certain features contained in a paper read at a meeting of the St. Louis Otolaryngological Society in December 1932.

From the Departments of Anatomy and Otolaryngology, Northwestern University Medical School. Contribution 293 from the former.

A summary of recent investigations into the structure of the temporal bone and of the ossicles which have been conducted under the auspices of the Central Bureau of Research of the American Otological Society, and, in part, a record of similar projects now under way at Northwestern University Medical School.

MATERIAL AND METHODS

The present report is based on the study of a large number of series in the otologic collection, from persons of various ages, the specific descriptions, however, are based on the following series, which are herein illustrated either as photomicrographs of sections or as photographs of wax plate reconstructions ¹

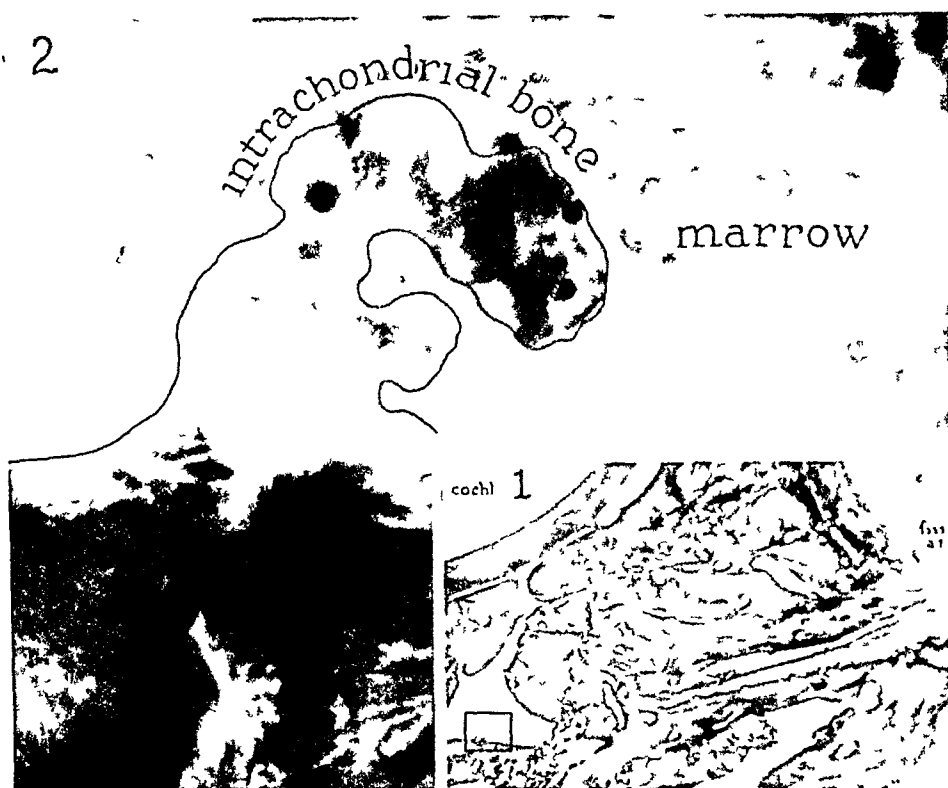
Age	Series	Sections	Sections, Figures	Reconstructions, Figures
Fetus, term	4/18/30	219	7, 8	
		230	9	
		260	10	
Fetus, term	March '27			13
3 mo	2/ 1/32	245	1, 2	
		250	3, 4	
		255	5, 6	
2 yrs	10/26/32			14
18 yrs	1/17/31			15
18 yrs	2/26/30			11, 12

OBSERVATIONS AND COMMENT

In any investigation into the formation and subsequent structural alteration of the temporal bone, it must be borne in mind that this skeletal element is, like all the others in the human body, impermanent. While it is recognized that the larger bones do not continue in the same state throughout life, this character of instability has only recently been studied in the temporal bone, the latter's otic capsule and the auditory ossicles.

Development of the temporal bone proceeds in a series of waves, affecting the several constituent parts at different stages. Within a few weeks, in the fetus, the otic capsule and the stapes attain approximately full size, subsequent growth is extracapsular and takes place in tissues which are destined to be mainly hemopoietic and pneumatic. But within the capsule itself, especially its fissular part, and within the stapes, gradual changes are going on which have to do with histologic metamorphosis rather than with growth, in the fissula certain of these changes are seemingly preparatory to the formation of otosclerotic bone.

¹ The photomicrographs were taken at the following magnifications: figures 1, 3 and 5 at 75 diameters, figures 2, 4 and 6 at 750, figures 7, 9 and 10 at 65, and figure 8 at 225. The reconstruction shown in figures 11 and 12 was prepared at a magnification of 50 diameters (by Dr J. E. Karabin), a reconstruction of the space enclosed by the fissula in this specimen is illustrated by B. J. Anson and J. G. Wilson (*The Fissula Ante Fenestram in an Adult Human Ear*, *Anat. Rec.* 56: 383-393 [July] 1933 and Anson and Martin (1935) ¹¹, the reconstructions shown in figures 13 to 15 served as bases for drawings in articles by Anson and Martin (1935) ¹¹ and Wilson (1935) ¹⁰, they were prepared at a magnification of 125 diameters.

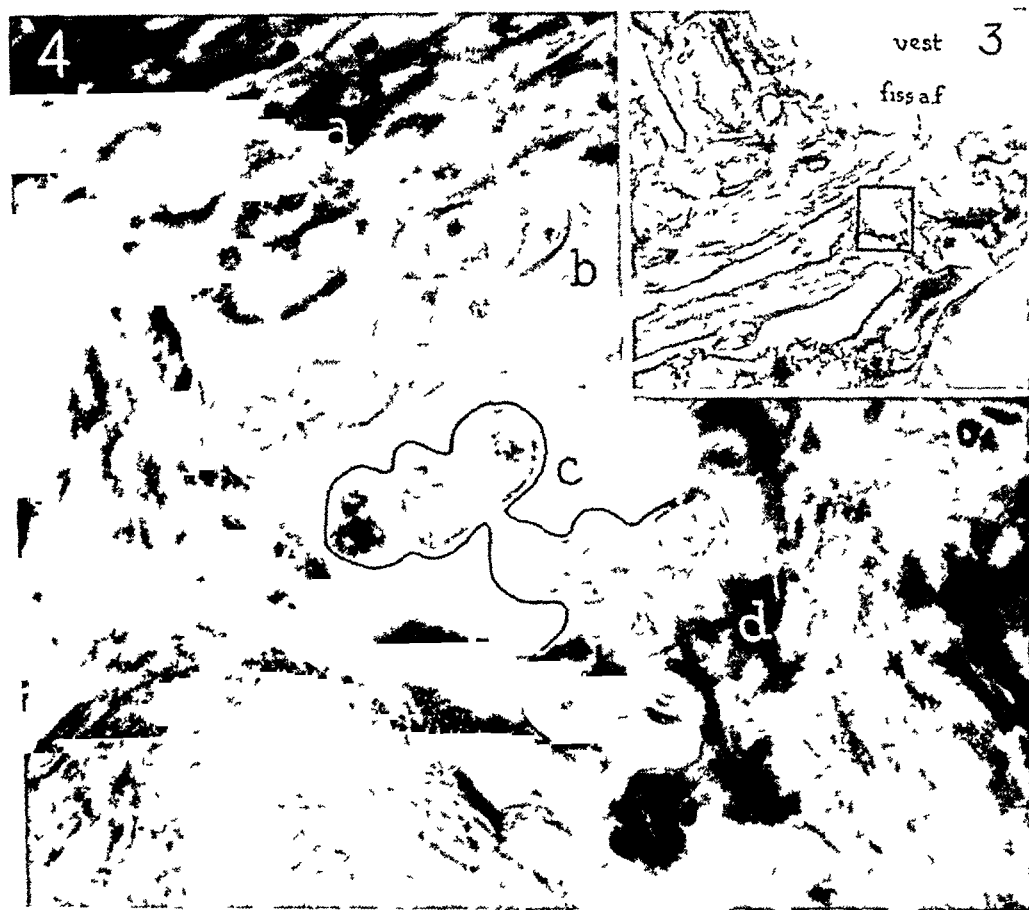


Figs 1 and 2—Photomicrographs of a horizontal section through the ear of an infant 3 months old. The area of bone is that part of the labyrinth bounded by the cochlea, the vestibule and the tympanic cavity. Figure 1 ($\times 40$) represents a section through the otic capsule just anterior to the stapes and in the region of the vestibular end of the fissula ante fenestram, showing the abundance of intrachondrial bone and the relation of such bone to the marrow spaces (see especially the small area enclosed by lines). Figure 2 ($\times 600$) represents an enlargement of the area marked out by lines in the preceding figure, showing a finger-like process of the resistant intrachondrial bone projecting into the loose and vascular connective tissue of a marrow space. The margin of the intrachondrial bone is indicated by a thin line.

In these and the succeeding figures, *ant* indicates the anterior aspect, *bst*, the base of the stapes, *car canal*, the carotid canal, *cart*, cartilage, *cochl*, the cochlea, *ct* or *conn tissue*, connective tissue, *fefaf*, the fenestral extremity of the fissula ante fenestram, *fissaf*, the fissula ante fenestram, *int ac meatus* or *int acoust meatus*, the internal acoustic meatus, *lat*, the lateral aspect, *lat semic canal*, the lateral semicircular canal, *med*, the medial aspect, *mm*, mucous membrane, *modiol*, the modiolus, *post*, the posterior aspect, *spu lam*, the spiral lamina, *spu tract*, the spiral tract, *stl*, the stapedial ligament, *tc*, *cavt* or *tymp cav*, the tympanic cavity, *te* or *tefaf*, the tympanic extremity of the fissula ante fenestram, *v*, *vest* or *vestib*, the vestibule, *ve* or *vefaf*, the vestibular extremity of the fissula ante fenestram, and *vest window* or *vestib window*, the vestibular window.

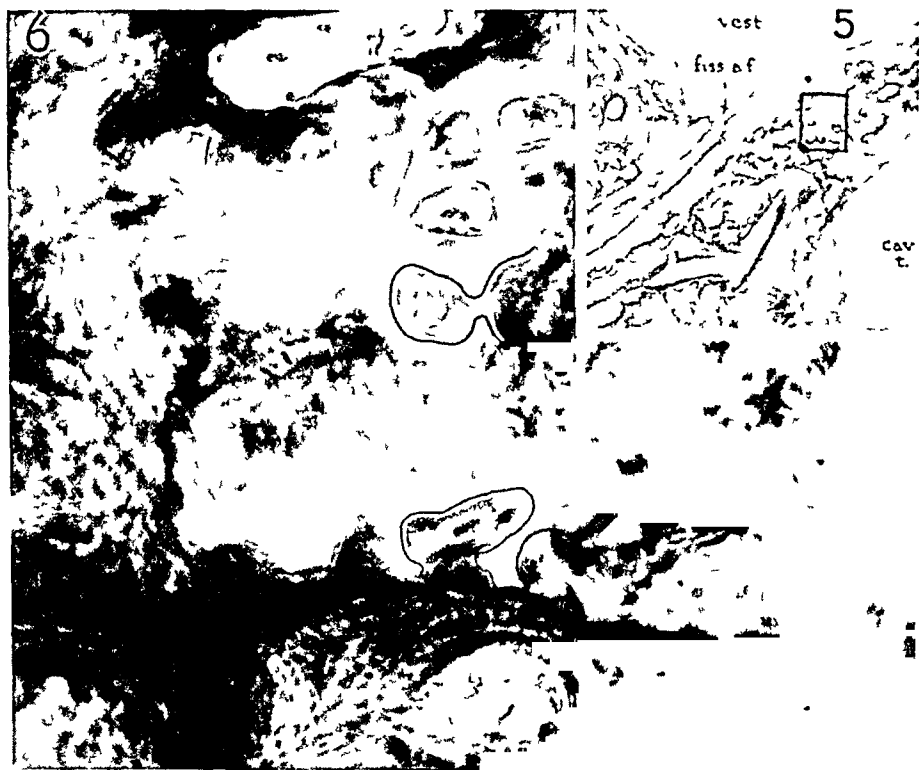
1 *Stapes and Vestibular Window*—In middle intrauterine life the stapes and the window in the otic capsule which receives the stapedia base are as large as they will ever be, but, although full size has been reached at this early stage, internal alteration, resulting in modification of external form, continues throughout life

The base of the stapes attains "adult" dimensions in the embryo of 161 mm, at this stage the first center of ossification has appeared on the tympanic surface of the base, thereafter, while the latter surface becomes fenestrated and the entire base hollowed, the vestibular surface remains covered with a layer of hyaline



Figs 3 and 4—Photomicrographs, continued, from a succeeding section in the same series. Figure 3 ($\times 40$) represents a section through the otic capsule in the region of the fissula, showing the typical hyaline cartilage (surrounding the end of the fissula), the modified cartilage of the intrachondrial bone and the endochondral bone. Figure 4 ($\times 600$) represents an enlargement of the area marked in the preceding figure (situated on the lateral wall of the fissula ante fenestram, near the vestibular extremity). At the top of the figure, from the surface inward, are observed transitional changes in the alteration of the cartilage cells and the containing lacunas (at *a* and *b*), toward the bottom are seen further stages in the conversion of lacunas into osseous capsules and the manner in which these become attached, in pedunculated form (at *c*), to the surrounding bony wall (at *d*). A stalk with a terminal cluster of cells in lacunas is outlined (at *c*).

cartilage (Anson, Karabin and Martin, 1938² and 1939³) Between the 183 mm stage and term, the fenestrated internal wall disappears, and the base is reduced to a relatively flat plate, cartilaginous on the vestibular, and osseous on the tympanic, surface Although it continues throughout life as a bilaminar plate, cartilage gradually gives way to bone In infantile and juvenile stages the base of the stapes is relatively thick, cartilage covering the vestibular aspect completely and also occurring on the tympanic surface in the form of small patches In adult stages, however, ossification has advanced to a point at which bone presses through the cartilaginous lamina, to appear on its free surface as islets, in the adult of 18 these are small and isolated, and at 57 some have coalesced to produce larger areas of bone, while in the subject of 70 bone covers approximately half of the surface Concurrently, the entire base becomes thinner, both laminae alike being affected



Figs 5 and 6—Photomicrographs, continued, from a succeeding section in the same series Figure 5 ($\times 40$) represents a section through the region of the fissula and the inferior aspect of the vestibular window, showing the arrangement of cartilage, intrachondrial bone and lamellar bone on the tympanic wall of the vestibule Figure 6 ($\times 600$) represents an enlargement of the area marked in the preceding figure The series of changes noted in figure 4 are here again apparent At the right of the field a modified, ossifying capsule is attached to the bony wall of the cartilage island by a thin pedicle, in the lower middle, one more thickly encapsulated is attached by a broader connection (each outlined) Others have become enclosed in the bone and appear as marginal crenations in a marrow space

2 Anson, B J, Karabin, J E, and Martin, J Stapes, Fissula Ante Fenestram and Associated Structures in Man I From the Embryo of Seven Weeks to That of Twenty-One Weeks, *Arch Otolaryng* 28 676-697 (Nov) 1938

(Footnotes continued on next page)

The crura also attain their full length in the 161 mm embryo, but are still solid cartilaginous bars, replacement of cartilage by bone progresses so rapidly that in the 183 mm embryo the crura are hollow osseous cylinders, perforated by vessels along their internal surface. Further resorption converts these hollow cylindric members into channeled structures, with their troughlike excavations mutually facing each other. Reduction in bulk, however, does not terminate with the attainment of sulcate form, since they become somewhat thinner as age advances.

The neck and head of the stapes are still continuous parts of a solid cartilaginous cylinder in the embryo of 183 mm, at which stage the crura have become hollow columns composed entirely of bone, but in the fetus at term, cartilage remains only on the articular surface of the head, the capital and cervical portions otherwise being osseous. In the adult a slow process of excavation alters the form of the neck and the head, often resulting in the removal of their superior surfaces.

Keeping pace with the changes which, in their steady advance, so completely modify the parts of the stapes, the window which receives the ossicle undergoes a similar morphogenesis. The window in early embryos is irregularly triangular, the base of the stapes being relatively much smaller than the fenestral space, in the embryo of 161 mm it has reached adult dimensions but not the typical adult form. The window is lined by a rim of cartilage throughout life, this fenestral cartilage diminishes as age advances, in old persons being approximately one half as thick as it is in midfetal life, yet it is never wholly replaced by bone. Representing a persistent portion of the primordial otic capsule, the cartilaginous fenestral rim possesses an extension at each extremity, the anteroposterior prolongation contains the fissula ante fenestram, the posteroinferior one surrounds the fossula post fenestram.⁴

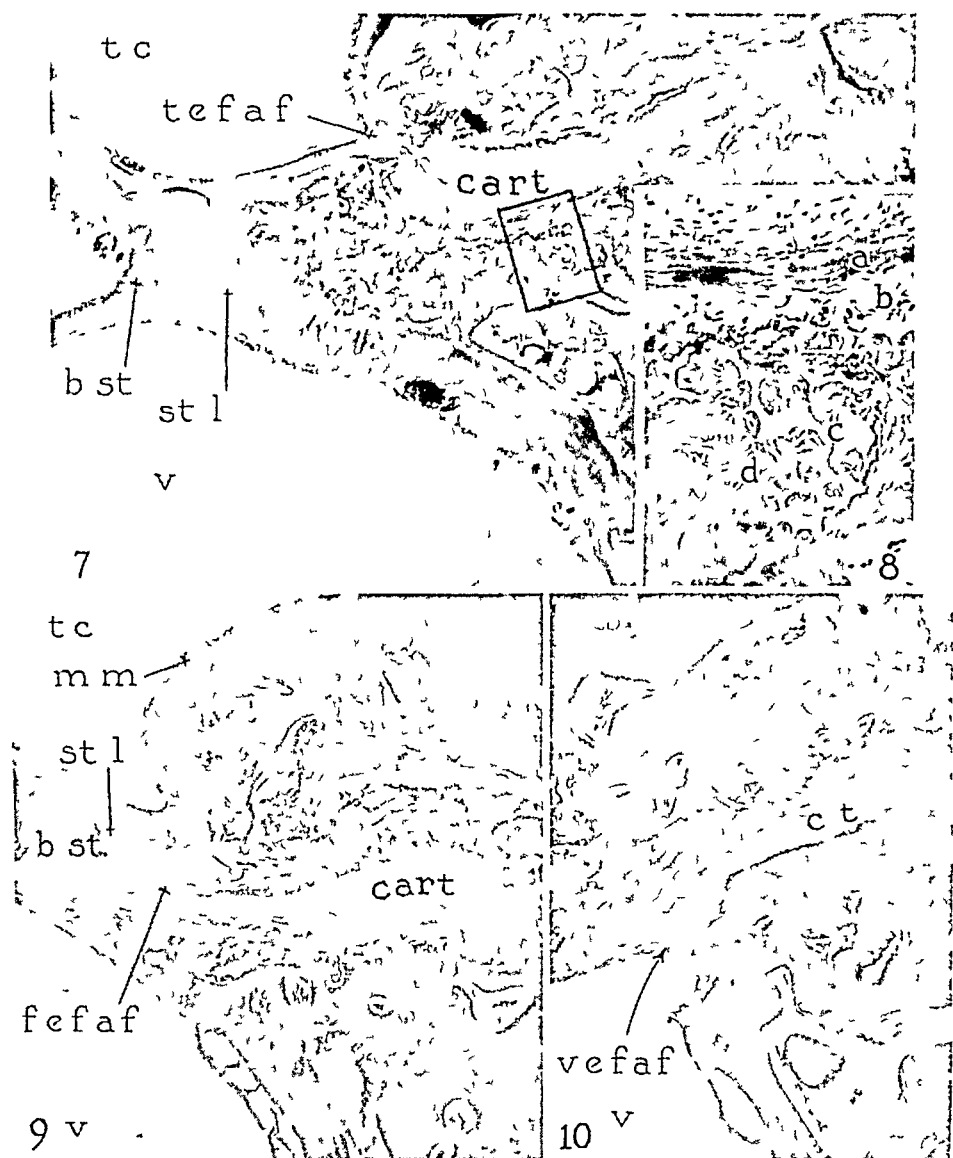
2 Semicircular Canals—In the embryo of 8 weeks the semicircular canals are still encased in cartilage, since their size will have increased by five times when maximum dimensions have been attained, "the tremendous growth and expansion of the canals must take place within this firm tissue" (Bast, 1932⁵). This expansion is accomplished

3 Anson, B. J., Karabin, J. E., and Martin, J. Stapes, Fissula Ante Fenestram and Associated Structures in Man. II. From the Fetus at Term to the Adult of Seventy Years, *Arch Otolaryng* **29** 939-973 (June) 1939.

4 The stapes, vestibular window and neighboring structures are now being studied in later fetal stages (3 month to term), by means of series which have been lent by Professor Bast. It may be recorded here, after a preliminary study of these fetal series, that in the specimen of 147 mm crown-rump length the stapes is still entirely cartilaginous and that calcification of the cartilage, with concurrent deposition of periosteal bone, is under way in the base of the stapes from a fetus of 150 mm, while in specimens of 160 and 163 mm excavation of the cartilage is already a striking feature. At 205 mm, the fenestrated bone on the facing surfaces of the crura and on the tympanic surface of the base has been largely removed, and new bone covers part of the cartilaginous lamina, the base is completely bilaminar in the fetus of 260 mm, at which stage its general structure and form are similar to those of the fetus at term. During the course of these changes the stapes retains the same over-all dimensions, when once bone appears, growth ceases.

5 Bast, T. H. Development of the Otic Capsule. I. Resorption of the Cartilage in the Canal Portion of the Otic Capsule in Human Fetuses and Its Relation to the Growth of the Semicircular Canals, *Arch Otolaryng* **16** 19-38 (July) 1932.

through a wide destruction of the cartilage situated between the arcs of the canals, a localized dedifferentiation of cartilage at the advancing margin of each canal with concurrent rebuilding of cartilage at the



Figs 7 to 10—Photomicrographs, horizontal sections through the fissular area in the ear of a fetus at term. Figure 7 ($\times 39$) represents a section through the tympanic extremity of the fissula ante fenestram, cartilage has replaced the earlier connective tissue of this lateral fissular orifice. Figure 8 ($\times 135$) represents an enlargement of the area indicated in the preceding figure, showing the histologic succession of tissue at the margin of the cartilage mass. The letters indicate stages substantially as in figure 4. Figure 9 ($\times 39$) represents a section through the auxiliary, or fenestral, orifice of the fissula, here, likewise, cartilage occupies the opening. Figure 10 ($\times 39$) represents a section through the vestibular extremity of the fissula, connective tissue remains at this medial orifice.

opposite receding margins. Approximately maximum growth, according to Bast, is reached in the midfetal stage, when ossification centers make their first appearance in the otic capsule. This means that, like the stapes and the vestibular window, the canalicular portion of the capsule is as large as it will ever be at the time the fetus is entering the second half of its period of intrauterine development.⁶

3 *Cochlea*—The cochlea, too, is approximately as large in the fetus of 4½ months as it will be in the adult and therefore belongs in a category with the portions of the ear already described. A slight enlargement may occur through expansion of the shell into the marrow space which regularly surrounds the cochlea in the late fetus and which still persists in the ears of some infants and children. This space matches roughly the form of the cochlea. Its outer wall is endochondral bone, its inner is hyaline cartilage and intrachondrial bone (see hereinafter). The latter tissues and the space which bounds them externally are reduced as age advances—perhaps partly by expansion of the cochlea through rebuilding of its wall.⁷ But since such growth, if it occurs at all, must be moderate, it may be said of the entire otic capsule that ossification is a process of differentiation unaccompanied by enlargement, unlike skeletal elements generally, it does not broaden or lengthen during the stage in which its cartilage is being replaced by bone.

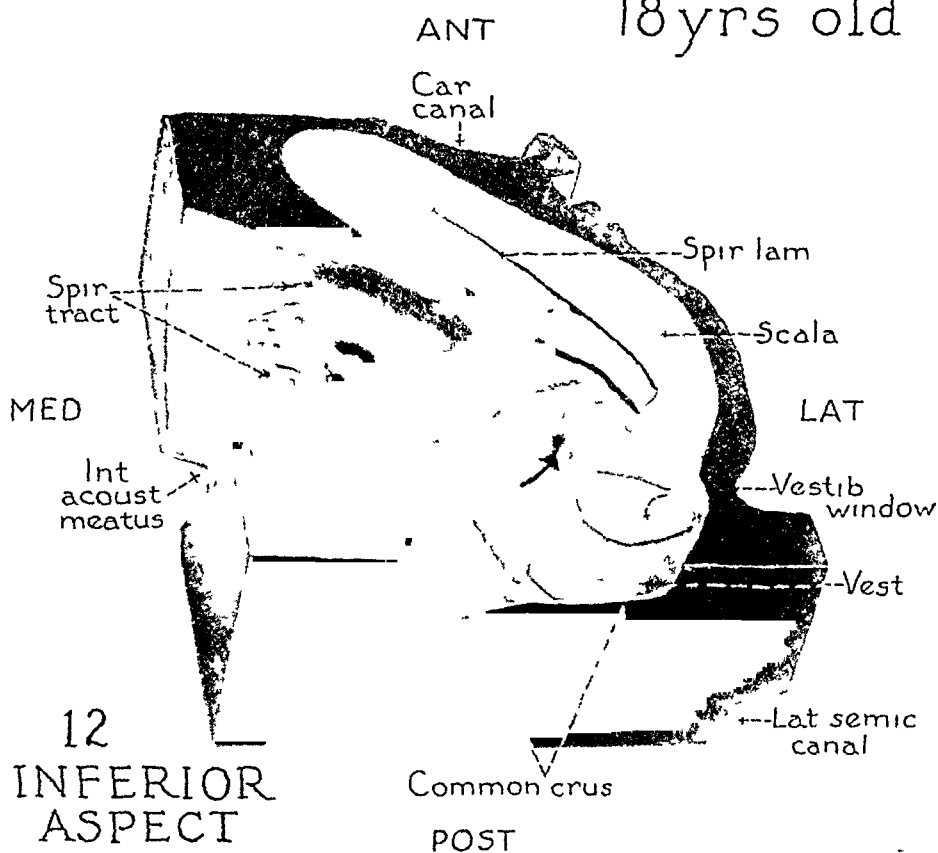
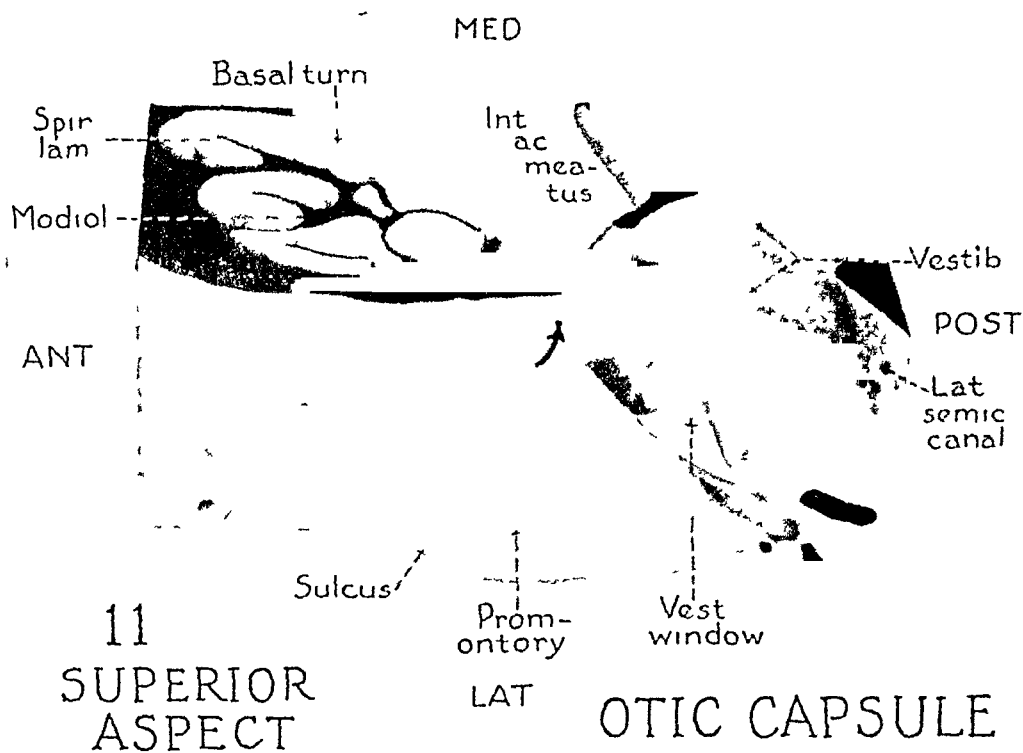
4 *Fissula ante Fenestram*—In the area of the otic capsule just in front of the vestibular window, between the latter and the cochlea, is situated a stripe of connective tissue, continuous externally with the submucosal connective tissue and internally with the perichondrium or periosteum of the vestibule, this fibrous seam in the bone occupies a channel termed the fissula ante fenestram. Like the capsule, of which it is a constituent part, the fissula has acquired adult dimensions when the fetus has but reached the halfway mark in its intrauterine life.⁸

Typically in specimens of temporal bone from adults, the fissular channel begins in a small opening on the medial tympanic wall just anterior to the vestibular window (fig 11, at arrow), extending at first inward toward the cochlea, it next turns backward upon itself,

6 The early attainment of full growth by the capsule and the ossicles is a striking phenomenon when it is considered that the weight of the human body will increase by fourteen times between the middle of fetal life and birth and by approximately three hundred times between the former stage and that of the 18 year old adult.

7 A study of the changing character of the tissues which form the immediate wall of the cochlea is in progress. It is hoped that, through the preparation of reconstructions of the constituent tissues, something may be learned about the function of intrachondrial bone.

8 In point of fact, owing to individual variation, the channel may actually be larger in the fetus than in some adults (Anson, Karabin and Martin, 1939,³ figs 60 to 64).



Figs 11 and 12—Reconstruction of the otic capsule, fissular orifices at arrows, $\times 7\frac{1}{2}$

descending as it does so it ends on the anterior wall of the vestibule at or near the point of continuity of the latter with the scala vestibuli of the cochlea (fig 12, at arrow, also, figs 1, 3 and 5) Variation in form and size is common. It may be short and slitlike or long and tortuous, it may be thin or bulbous⁹

But more important than variation in shape of the fissula is variation in contents (see the paragraph headed "Primary Cartilage") The area is commonly found to be in a state of histologic flux (Wilson, 1935¹⁰) The most striking result of cellular disequilibrium is the production of unusual tissues for example the osteoporotic type of bone present in cases of otosclerosis (Anson and Martin 1935¹¹)

The bone enclosing the fissula often measures not more than 0.5 mm in width 1.2 mm in length and 1.6 mm in height, but in spite of the small size great interest attaches to its histologic fate since it is here that sclerotic bone occurs with such frequency that the region has come to be known as the "site of predilection for otosclerosis" Small as is the fissula the vestibular window is but little larger; consequently, any deforming effect which changes, initially fissular may have on the neighboring window will be vitally important Newly formed bone by encroaching on the space, will reduce the excursion of the stapes and thereby cause a loss of acuity in hearing Although it is recognized that these alterations are not "pathologic" in the sense in which the term is employed in the description of say osteosarcoma they nevertheless produce results which certainly are abnormal In order to appreciate these effects fully, it is necessary to think in terms of slow progress, unlike the dramatic advance which marks the spread of neoplasms, and to recognize that alterations in structure which would be infinitesimal in the gross pathologic picture of other members are here of grave importance

The region of the fissula ante fenestram is then, one of vital importance, since spongy foci, appearing originally in relation to the fissula may spread into the fenestral space and so involve the base of the stapes In order to understand the principles of fissular morphology it is necessary first to review the stages in the development of the capsular bone and in the formation of the special group of tissues in the territory of the fissula

9 Selected specimens exhibiting variety in form, terminations and contents have been described by Bast and by Wilson Anson and associates in articles which will be referred to hereinafter The fissula is not infrequently incomplete lacking one or both orifices The extremities of the fissula may open not near the vestibular window but into the semicircular for the tensor tympani muscle the vestibular orifice may open not into the vestibule proper but into the scala

10 Wilson J G Fissula Ante Fenestram and the Adjacent Tissue in the Human Otic Capsule *Acta oto-laryng* **22** 382-389 1935

11 Anson B J and Martin J Fissula Ante Fenestram Its Form and Contents in Early Life, *Arch Otolaryng* **21**:303-323 (March) 1935

Fig 13

FETUS,
TERM

VARIETIES of FISSULAR TISSUES

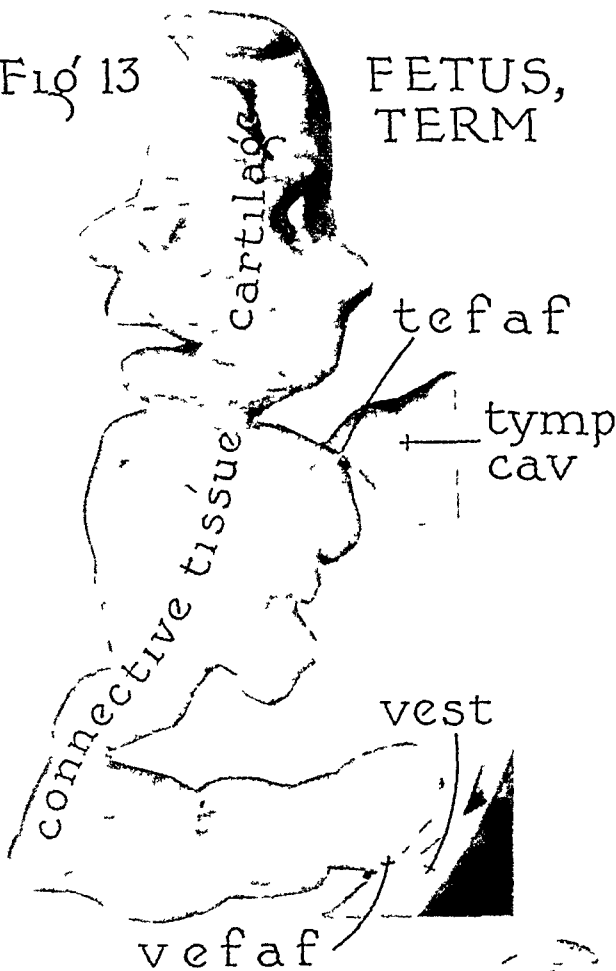
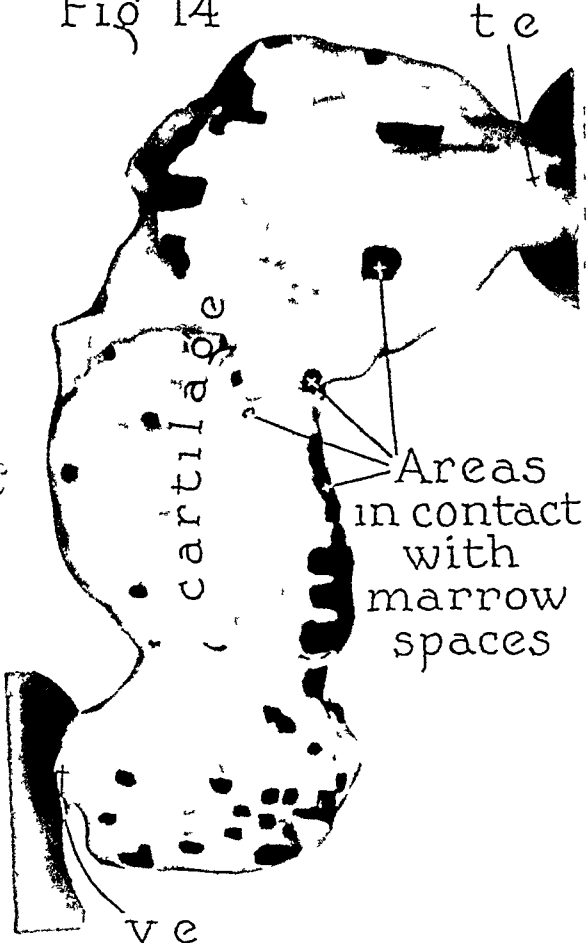
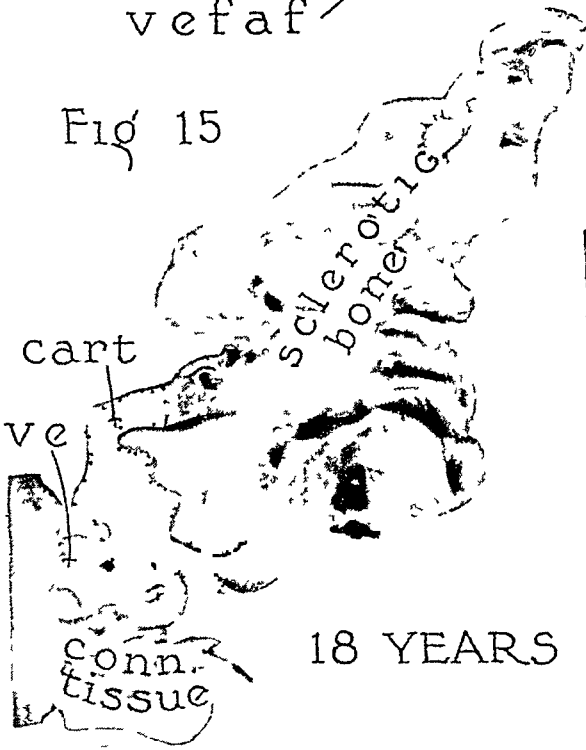


Fig 14



2 YEARS

Fig 15



18 YEARS

Figs 13 to 15—Reconstructions of fissular contents, $\times 42$ Figure 13, a medial view of the reconstruction, shows connective tissue and cartilage Figure 14, an anterior view, shows cartilage Figure 15, a medial view, shows cartilage (stippled) and sclerotic bone

The cartilaginous otic capsule of the primitive chondrocranium is converted into an osseous case through the production of bone from a number of centers of ossification

Within each of the centers of ossification, as shown by Bast (1930),¹² a succession of changes occurs, some of which match those which take place in any long bone in the human body, while others are peculiar to the otic capsule

Periosteal (or perichondrial) bone appears first, in the form of a layer investing the primordial cartilage, its matrix is deposited by cells derived from the perichondrium of the otic capsule, it closely resembles in every respect the comparable tissue of any developing long bone

The enveloping plate thus constructed is foraminous, permitting the entrance into the subjacent cartilage of buds of vascular tissue, whose source is, again, the perichondrium Individual cells from the osteogenetic buds invade lacunas of the necrotic cartilage and excavate the latter tissue Then, as in membrane bone generally, endochondral (or primary) bone is produced in the excavated spaces Usually it remains in the capsule throughout life, little of it being replaced by haversian (or secondary) bone

A third and special type of bone is formed in the capsule, as a result of the rapidity of invasion When the osteogenetic buds become vascular, their growth is exceedingly rapid, sufficient time, apparently, is not allowed for complete removal of the cartilage matrix As a result, areas of hyaline cartilage are left standing between the invasive buds The lacunas of the partially destroyed cartilage are invaded by the cells of the osteogenetic buds, these, becoming osteoblastic, deposit bone around themselves on the wall of the lacunas, giving to the tissue the appearance of a calcified cartilage These cartilage islands (interglobular spaces, or "intrachondrial bone" of Professor Bast's descriptions) are to some extent destroyed, osteoclasts excavate a channel through the calcified wall, removing the matrix and contained cells and replacing the calcified cartilage with endochondral bone Since intrachondrial bone is, generally, not as widely distributed in the old as in the young, it seems safe to assume that this process continues in postnatal stages

The process of ossification of the otic capsule begins in about the sixteenth week of intrauterine life Centers appear in rapid succession and fuse to produce a complete osseous capsule in the fetus of approximately 22 weeks (Bast, 1930¹²) The fissular region, however, is slow to ossify, appearing as a considerable mass of cartilage in the fetus of 21 weeks (183 mm), it extends from the cartilaginous rim of the vestibular window to the cochlea, forming part of the latter's posterolateral wall (Bast, 1930,¹² figs 25 and 27, Anson, Kaibin and Martin, 1938,² figs 20 and 21) At the core of this seam of cartilage is a strip of connective tissue which extends through the capsular wall from the tympanic to the vestibular surface, on the outer aspect of the cartilage is an investment of periosteal bone from which project trabeculate formations of endochondral and intrachondrial bone The osseous shell,

¹² Bast, T H Ossification of the Otic Capsule in Human Fetuses Publication 121, Carnegie Institution of Washington, 1930, Contrib Embryol **21**:53-82 (June) 1930

by accretion, becomes part of the general petrous mass, the cartilage is seemingly reduced in bulk by slow conversion into "cartilage islands"

Established, then, at the midfetal stage is the association (in the small area just in front of the vestibule) of fibrous, chondral and osseous tissues. Connective tissue is embedded in cartilage, the latter is encased in bone (figs 1, 3, 5 and 10)

These tissues, initially present, and others, which in some specimens replace them, will now be discussed

(a) *Connective Tissue* Connective tissue is the usual occupant of the fissular channel. It is formed by a process of dedifferentiation of the cartilage composing the primordial capsule (Bast, 1930¹²), the process is similar to that which occurs in the expanding canalicular area, as has been described. Whether examined in the late fetus or in the old adult, it is found to be but slightly vascular. At its margins the fibrous tissue passes gradually into cartilage or bone, through a perichondrium or a periosteum as an intermediary tissue.

(b) *Primary Cartilage* That part of the original capsular tissue in which the connective tissue is embedded persists as a more or less complete chondral tube throughout life (figs 1 to 6). Large in the 183 mm fetus (Anson, Karabin and Martin, 1938,² figs 20 and 21) it regularly decreases in thickness as age advances. The cartilage is apparently taken over into endochondral or intrachondrial bone by slowly progressing osteogenesis, since in some old subjects it remains as a readily distinguishable layer only at the vestibular extremity of the fissula, still continuous, however, with the fenestral cartilage (Anson, Karabin and Martin, 1938,² figs 22 and 23), through the body of the fissula and at the latter's tympanic orifice in such instances the fibrous tissue rests directly against the osseous tissue of fissular wall.

(c) *Calcified Cartilage (Cartilage Islands)* Part of the wall of the fissula in late fetal and in postnatal stages is composed of intrachondrial bone. Where the primordial cartilage persists as a tube external to the connective tissue and internal to the bone, the intrachondrial tissue—midway in structure between cartilage and true bone—exists as a stratum of varying thickness on the outer aspect of the cartilaginous tube. As has been explained this intermediate type of tissue is formed through the ossification of remnants of cartilage which were left undestroyed by the invasive osteogenetic buds, thus sequestered during the period of fetal development, it endures, as a histologic half-caste, in the otic capsules of persons 70 and 80 years of age.¹³

13 The histologic mechanism by which a cartilaginous matrix is converted into a "bone within cartilage" has been fully described by Bast (1930)¹². The persistent hyaline cartilage is gradually converted into a peculiar sort of calcified tissue, osteogenetic buds, derived from the perichondrium, invade the lacunas, to replace the cartilage cells and deposit a bony shell around themselves on the inner aspect of the original lacunas.

In the region between the cochlea and the vestibular window (i. e., the fissular region), this hybrid tissue is especially abundant, but from a site in the fissular wall it may extend deeply into the surrounding capsule (figs 3 to 8). In passing from the chondral lining of the fissular space into the deeper tissue, a gradual histologic transition is encountered, beginning with cartilage and ending in true bone, the intermediate tissue being the "cartilage islands." In the layers bordering the fissular channel the cartilage cells lie in typical lacunas, composed of hyaline material homogeneous in texture. Nearer the bone the lacunas are larger and the intracellular material more deeply stained. Where cells are actually related to bone (as at the margin in fig 4) they are encapsulated by a tissue which is definitely osseous. Various degrees of inclusion are frequently seen in the same section (figs 5 and 6), attachment may consist of a narrow pedicle or of a broad stalk, finally the cell may be buried in bone, so that, with its neighbors, it lends an appearance of crenation to the periphery of the cartilaginous area. The cartilage is avascular, wherever vessels occur they are surrounded by bone, although this osseous rim is in some instances exceptionally thin.

Once formed, the intrachondrial bone is apparently a more resistant tissue than the endochondral bone, frequently it is found projecting prominently into the marrow spaces as tongue-like or finger-like prolongations, continuous with collections of the same tissue which are embedded in the ordinary bone of the capsule (figs 1 and 2). The jagged form of these projections indicates that some process of halisteresis has been operative, but less successfully against the intrachondrial than against the endochondral bone.

These persistent remnants of cartilage—changed from their original form without loss of histologic identity—vary in abundance in different persons of the same age and in persons of different ages. Usually, they are more widely distributed in late fetuses and in children than they are in old adults, in the ears of both the young and the aged they are likely to be most plentiful in the innermost layers of the otic capsule, lying adjacent to the labyrinthine wall, the "islands" are often concentrated in that portion of the wall which, intervening between the cochlea and the vestibular window, houses the fissula ante fenestram¹⁴

14 This particular phase of capsular metamorphosis is being studied in a large number of series representing ages between that of the late fetus and that of the adult of advanced years. It may be stated now, however, that the differences noted in the abundance of the intrachondrial bone are probably established during the ossification of the otic capsule. As Professor Bast has pointed out, in recent discussion of our otologic studies, the destruction of cartilage is exceedingly rapid in the otic capsules of some fetuses and slow in those of others, when it is rapid, few islands of cartilage remain to serve as a framework for intrachondrial bone, when it is slow, such patches persist to behave as nuclear centers for the deposition of bone.

When, as has been previously mentioned, the cartilaginous lining of the fissular channel is poorly represented, intrachondral bone is likewise sparingly distributed in the immediate wall of the fissula. Whether replaced through a tardy process of osseous encroachment or sparsely present from the fetal period onward, the intrachondral tissue is still usually to be found at the vestibular extremity of the fissula ante fenestram. In such cases, which ordinarily are those of old adults, the fibrous content of the fissula rests against the bone except at the medial fissular orifice, where cartilage intervenes.

(d) Endochondral Bone. The true bone of the fissular region is primary bone, like that which makes up the bulk of the entire capsule.

As Bast has shown, ossification of the otic capsule is progressing rapidly in the 161 mm stage, in the fissular region it begins on the medial tympanic wall and extends into the cartilage toward the fissular tract of connective tissue (Bast, 1933,¹⁵ figs 9 and 10). In the fetus of 210 mm periosteal (perichondrial) bone has spread to the walls of the vestibule and the cochlea and along the course of the fissula (Bast, 1933,¹⁵ figs 13 to 15). In the 305 mm fetus endochondral bone is beginning to obliterate the primitive marrow space bounded by the tympanic, vestibular and cochlear plates of perichondrial bone (Bast, 1933,¹⁵ figs 21 to 24). Part of this endochondral bone is deposited on the intrachondral tissue, the latter then remains in the form of islands when endochondral bone has largely displaced marrow.

Modification of the bone next ensues, and it soon becomes impossible to distinguish the two types, which during the period of fetal ossification were characteristic in position and configuration.

In respect to density, the capsular bone, in postnatal stages, exhibits striking variations, in some specimens the bone is "petrous," containing few marrow spaces, while in others marrow spaces are large and numerous and the intervening trabeculae small. Occasionally, the marrow occupies large cavities continuous with the space of the fissula ante fenestram (Anson and Martin, 1935,¹¹ fig 58, Wilson, 1935,¹⁰ fig 10). It is conceivable that within the otic capsule marrow spaces increase with advancing age, to produce a condition of rarefaction comparable with that occurring in the stapes.

(e) Secondary Cartilage. The fissular tube of primary cartilaginous origin is relatively bulky at the midfetal stage, as already described, it extends anteriorly to the cochlea and forms part of the latter's wall. In later stages this cochlear extension is replaced by bone and the fissular cartilage reduced to surround a fibrous core.

While the original cartilage which forms the wall of the fissular channel is thus progressively encroached on, new cartilage, in the form of a solid mass, may come to occupy all or part of the channel, replacing

15 Bast, T. H. Development of the Otic Capsule. II. The Origin, Development and Significance of the Fissula Ante Fenestram and Its Relation to Otosclerotic Foci, *Arch Otolaryng* 18 1-20 (July) 1933.

the original connective tissue. Such replacement occurs commonly in the late fetus, the infant and the child. In a recent examination of twenty-seven series of temporal bones from fetuses at term, infants and children (to the age of 10 years) the fissular tract in 16 was found to be occupied by a cartilaginous mass. The form of such chondral masses has been described and figured by Anson and Martin (1935),¹¹ Wilson (1935)¹⁰ and Bast (1936)¹⁶

As shown by Bast (1936),¹⁶ the cartilaginous masses of secondary formation appear for the first time in older fetuses, the earliest stage in which one was noted was a fetus of 180 mm (21 weeks). The manner of its origin and spread and the mechanism by which it is subsequently reduced in bulk or replaced by a more active tissue will now be considered.

The new cartilage, which, as a secondary growth, comes to occupy a fissular channel once filled with fibrous tissue, is derived from the dormant shell of similar tissue which lines the channel (Anson and Martin, 1935¹¹, Bast, 1936¹⁶), there being a gradual histologic transition from perichondrial connective tissue to newly formed cartilage.¹⁷ Bast (1936)¹⁶ stated that this replacement is an attempt on the part of the bone to reduce the extent of the fissular space, since the activated cartilage appears at an embryologic age when ossification of the capsular cartilage should have been completed and later may undergo ossification marginally.

In the temporal bone from a child 2 years old the occurrence of precociously developed cartilage within the fissular space makes clear the manner in which the new tissue gradually displaces the original connective tissue of the fissula to produce a chondral nodule within the bone between the cochlea and the vestibular window. At the tympanic orifice the new cartilage bulges into the semicanal of the tensor tympanic muscle, at the vestibular extremity it pushes toward the mouth of the orifice, where some of the original connective tissue still remains, at intermediate points it presses into marrow spaces (fig 14, dark areas). At each extremity of the mass there is a gradual transition from perichondrial connective tissue into newly formed cartilage.

Of a different order, of course, is the cartilage which lines the fissular orifice and against which the newly formed cartilage lies; it is mature tissue which has been present in this locality from the stage

16 Bast, T. H. Development of the Otic Capsule. III. Fetal and Infantile Changes in the Fissular Region and Their Probable Relationship to the Formation of Otosclerotic Foci, *Arch Otolaryng* 23:509-525 (May) 1936.

17 It should have become clear to the reader that the fissula in histologic preparations is never a true fissure. Presumably because the fissula ante fenestram was first studied in dried bone by the simple method of probing, the structure is spoken of as if it were a true space (see bibliography in Bast, 1930¹²).

of embryonic formation. It passes imperceptibly into the intrachondrial bone which intervenes between the mass of young cartilage and the bone (figs 7 and 8), at no point does the mature cartilage of the fissular shell or the intrachondrial bone pass by an intermediate transitional tissue into the young (activated) cartilage which occupies the fissula. It may, therefore, be said that the cartilage in many young specimens occurs not only as a parietal investment for the connective tissue of the fissula but as a nodular mass also, which partially or wholly replaces that tissue.

Occasionally the nodule is situated above the level of the tympanic orifice of the fissula. In a fetus at term, for example, the lower portion of the fissula terminates above and below in orifices that are occupied by connective tissue (fig 13), but in an upward extension of the channel, two thirds as long as the fissula proper, the activated cartilage occurs as a discrete mass. Assumedly, in further spread, the cartilage would have taken the place of the connective tissue from the tympanic to the vestibular extremities.

The cartilage mass is related, in some specimens, not only to the tympanic extremity (fig 7) but to an auxiliary fenestral extremity (fig 9) where it is mergent with the lining of the vestibular window, as in the specimen illustrated, it frequently fails to reach the vestibular orifice (fig 10). Here again the new cartilage is set off sharply from the fissular shell, the tissue of the latter, however, passing by gradual transition through intrachondrial bone into the endochondral bone of the capsule (fig 8)—wall and content remaining separate entities.

The tissue of the chondral nodule, having replaced the fibrous portion of the fissula, undergoes alteration within its own mass. Once formed, its matrix changes character, staining deeply with hematoxylin, since this is what happens in cartilage generally just prior to invasion by osteogenetic buds, it appears that the cartilage "has reached the final stage preceding the process of ossification." Supportive evidence is seen "in some of the older ears, in which the cartilage mass is being replaced by osteoid tissue or even by intrachondrial bone" (Bast, 1936¹⁶). Through the operation of such a process the occurrence of isolated masses of cartilage is explained (Anson and Martin, 1935,¹¹ figs 46 to 49), in such cases the channel is incomplete, the expected site occupied by endochondral bone and discontinuous chondral nodules.¹⁸

18 It is present opinion that the fissula is not as frequently obstructed in the old as in the young—a baffling circumstance, if true. But it is not definitely established that the regular content of the adult fissular channel is connective tissue. The fissula is now being studied in a large series of sections, and in the following three groups: fetuses at term to children of 10 to 12 years, older children to young adults (21 years) and adults to the age of 80. A comparison of types by ages should put light on the problem of the ultimate fate of the fissular tissues.

Except for local protrusion of the cartilage into marrow spaces opening on the fissular wall (fig 14), there is no indication that the activated tissue invades the surrounding capsule, so far as observed, it never occasions atrophy of the fissular shell

(f) Sclerotic Bone When sclerotic bone occurs within the confines of the fissula, however, the primary bone of the otic capsule may be replaced to some extent, since this new osseous tissue is mildly invasive, spreading, it may replace the quiescent cartilage of the vestibular window and appear in close proximity to the base of the stapes (Wilson and Anson, 1933,¹⁹ plates I and IV, Bast, 1933,¹⁵ fig 36)

In a specimen from an adult 18 years old the fissular area is remarkable for the manner in which it is occupied by a lump of sclerotic bone (fig 15) At the inferior fissular extremity fibrous tissue gives way to cartilage, the latter then merging with vascular, spongy bone of the sclerotic type, which extends anterosuperiorly toward the cochlea The mass is strikingly irregular, bearing numerous projections At the tympanic extremity, the sclerotic bone is exposed to the mucous membrane without the intermediation of cartilage or connective tissue, here, as well as at the vestibular extremity, the fissular channel is still lined by cartilage Had the fissula in this specimen possessed an auxiliary, or fenestral, orifice (fig 9) and had the new sclerotic bone followed such a preexistent channel, invading the vestibular window, fixation of the stapes would have resulted from impingement of the sclerotic bone on the stapedial base

It is quite conceivable also that the newly formed cartilage (fig 9), were it to protrude into the vestibular window, as it has in other specimens been observed to project into the semicanal of the tensor tympani muscle, might embarrass the stapes in its excursion, calcification of the tissue within the stapedial (annular) ligament would, of course, result in fixation of the stapes

5 *Fossula post Fenestram*—The fossula post fenestram is generally similar to the fissula ante fenestram in development and in structure (Bast, 1938²⁰), but it is usually smaller The fossula, according to Bast, is less frequent in occurrence than the fissula, being present in 67 per cent of the ears studied, in only 25 per cent of the ears possessing a fossula is the channel complete, i e, extending through the wall of the otic capsule without interruption from the vestibule to the tympanic cavity So far as observed the fossula does not display a similar variety of tissues it does not contain activated cartilage or sclerotic bone For

19 Wilson, J G, and Anson, B J Form and Structure of an Area of Otic Sclerosis in the Temporal Bone of an Adult, Arch Otolaryng **18** 291-297 (Sept) 1933

20 Bast, T H Development of the Otic Capsule IV The Fossula Post Fenestram, Arch Otolaryng **27** 402-412 (April) 1938

this difference between the fissula ante fenestram and the fossula post fenestram we are unable to offer an explanation

6 *Extracapsular Tissues*—From measurements made on a collection of skulls we find a marked increase of the petrous portion of the temporal bone between fetal and adult stages, its length in the adult is one and a half times as great as that of the bone in the fetus at term, its width is virtually doubled. Thus, while the essential portions of the contained labyrinth remain unaltered after the fetal size is attained, the encapsulating bone undergoes marked increase in dimensions

The enlargement of the petrous portion is due almost entirely to increment in tissues external to the otic capsule, since the "adult" dimensions of the combined cochlear and canalicular portions are attained in midfetal life. But between the later fetal and the early juvenile stages an extensive mass of pneumatic and marrow tissue is added, chiefly to each extremity of the primitive capsule, the addition at the anteromedial extremity (so-called apex or tip) being especially striking.²¹ In a case already reported on, the air cells almost completely surround the carotid canal, extending from the very tip of the petrous portion to the cochlear area, in the latter situation they lie on both medial and lateral aspects of the cochlea, immediately against the bone of the otic capsule, communicating with the tympanic cavity on one side, they extend across the bone to its inner table on the opposite side. The highly trabeculate character of the bone and the vascular nature of the submucosal and marrow tissue no doubt account for the rapid extension of these extracapsular areas.²²

CONCLUSIONS

The temporal bone, as a whole, exhibits a progressive set of changes, which continue through the life of the subject. They belong in two categories, growth and internal alteration in the otic capsule and the associated stapes

21 The air cells are abundant in the young child, indicating that development in early postnatal stages is rapid. At present we are studying these cells in representative specimens of several age groups, we have already presented an account of their wide distribution in the child of 4½ years (Anson, B. J., Wilson, J. G., and Gaardsmoe, J. P. Air Cells of Petrous Portion of Temporal Bone in a Child Four and a Half Years Old, *Arch Otolaryng* 27 588-605 [May] 1938). Wax plate reconstructions are being prepared from representative series in order to demonstrate the form and topographic relations of the cells satisfactorily.

22 The anatomy of the petrous portion of the temporal bone exclusive of the otic capsule and its contents has been presented in an excellent article by S. R. Guild (Normal and Pathological Anatomy of the Petrous Pyramid, *Tr Am Otol Soc* 25 165-179, 1935), therein are considered the framework of the pars petrosa, the marrow and the air cells which are contained within it and the nerves and vessels which traverse it en route to destinations outside the temporal bone.

The several centers of ossification which give rise to the otic capsule have coalesced in the midfetal stage, yet the petrous portion continues to enlarge, pneumatic and marrow tissues being added after birth, the mass of the encapsulating element increasing while that of the contained labyrinthine core retains essentially fetal dimensions

Similarly, the fenestral opening (vestibular window) in which the base of the stapes rests has attained adult dimensions during the first half of fetal life, so also has the stapes itself. Yet the rim of hyaline cartilage which lines the window is gradually reduced in breadth and thickness as age advances, being much thinner in the old adult than in the fetus of 4 or 5 months. Concurrently, the stapes is changed in early fetal stages from a cartilage having a solid base, crura and head to one of much more delicate structure, predominantly osseous—possessing crura of troughed form, an excavated head and a thin bilaminar base. Replacement of cartilage by bone then continues slowly throughout life.

These structural alterations in the window and the ossicle are accomplished without change in over-all dimensions. In the same category belong the fluctuations which mark the special area of the otic capsule situated between the vestibular window and the cochlea, here is situated the fissula ante fenestram, and here occur abnormal changes with such regularity that the area is referred to clinically as the "site of predilection" for otosclerosis. Although the entire region of the fissula may not exceed 1 cu. mm, it is nevertheless the scene of histologic reconstruction profoundly important to the subject.

The fissula ante fenestram is typically an irregular channel through the temporal bone situated in front of the vestibular window, in the cleaned skull it is an open channel, admitting a bristle, but in the natural state it is occupied by fibrous tissue. Its immediate wall is formed by cartilage, which, like the cartilaginous content of the stapes or the chondral lining of the vestibular window, is a remnant of the originally larger collection of the same tissue, gradually encroached on by bone.

But the changes are not merely those of slow replacement of one tissue by another, certain other, more rapid alterations occur, which mark the area as histologically unstable. These seem to be related fundamentally to the secondary formation of hyaline cartilage, derived from the cartilaginous lining of the fissular channel. Displacing the fibrous tissue of the fissula, the nodule of newly formed tissue extends through the length of the original channel, it may not only extend to the regular tympanic and vestibular orifices but also occupy the auxiliary opening at the vestibular window. Under these circumstances the cartilaginous lining of the fissula and the encapsulating bone are the site of only the slightest activity. Here an intermediate tissue is present, derived from hyaline cartilage but usurped by bone, this tissue, formed initially as

cartilage, is invaded by osteoblasts, which convert the matrix into a calcified structure. Seemingly resistant to rapid change, this hybrid tissue ("intrachondrial bone" or "cartilage islands"), gradually incorporated into the wall of the fissula, remains readily distinguishable from the mass of activated cartilage, when such occurs, one is quiescent in character and constitutes part of the fissular wall, the other is active and is situated within the fissular channel, they seem independent, the less active being resistant to the more active tissue.

But within the fissular channel another type of tissue occurs which is sufficiently invasive to replace, in succession, any fibrous tissue remaining in the fissular channel, the newly formed cartilage located there, the older hyaline cartilage and intrachondrial bone of the fissular wall and finally the endochondrial bone which immediately borders the fissular wall. This mildly invasive tissue, much more vascular than the other tissues of the otic capsule, spreads beyond the normal confines of the fissula, occasionally to reach the anterior wall of the vestibular window and to reduce the latter's space. After having taken the place of the hyaline cartilage which forms the primordial fenestral wall, the sclerotic bone, should it impinge on the base of the stapes, would fasten the ossicle within the window.

The total area affected by these processes is relatively small, so that an otosclerotic nodule of minute proportions may profoundly alter the equally small window and stapes, it is, so to speak, a pathologic process on a diminutive scale.

CONGENITAL CYSTS OF THE LARYNX

REPORT OF A CASE

GORDON B NEW, M D

AND

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ROCHESTER, MINN

Congenital or embryonic cysts of the larynx are of interest to the laryngologist primarily because of their extreme rarity. In fact, any type of cyst is seen rather infrequently in this region. Of 722 cases of benign laryngeal tumors encountered at the Mayo Clinic prior to 1938, only 35 were cases of cysts, and in but 1 was the cyst of embryonic origin. This case was reported previously¹. Since then we have encountered 2 other cases of congenital cysts of the larynx, of which we wish to mention 1 and to report the other at this time.

Cysts of the larynx are of three types, namely, mucous, hemorrhagic and congenital. Most common are the mucous cysts, their etiology undoubtedly points to an inflammatory basis which results in an obstruction of the ductal portion of a mucous gland. Because of this atresia, the mucus is unable to escape and accumulates within the glandular lumen. The effect of such a process is the production of a cyst. If the tumor does not become too greatly distended with mucoid secretion, the normal columnar or cuboidal glandular epithelium will be retained as the lining of the cyst. However, as the tension of the contained fluid increases, the epithelial cells become markedly flattened. With further expansion of the cyst, atrophic changes occur in the epithelium, which finally disappears altogether. This process affords an explanation as to why the great majority of mucous cysts, on removal, are found to be lined not with epithelium but with a smooth layer of fibrous connective tissue, the growth of which is stimulated by the irritative effects of abnormal tension. Although mucous cysts may occur anywhere within the larynx, they are encountered most frequently, as would be expected, in the vicinity of the epiglottis, where the mucous membrane is abun-

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1 (a) New, G B. Cysts of the Larynx, *Journal-Lancet* **37** 99-102 (Feb 15) 1917. (b) New, G B, and Erich, J B. Benign Tumors of the Larynx. A Study of Seven Hundred and Twenty-Two Cases, *Arch Otolaryng* **28** 841-910 (Dec) 1938.

dantly supplied with mucous glands. Many mucous cysts in the larynx reach significant dimensions, but few, if any, attain the large proportions of a congenital cyst.

Although uncommon, hemorrhagic cysts occur much more frequently in the larynx than do those of embryonic origin. After an extravasation of blood into the tissues, if the blood is not absorbed, fibroblasts may proliferate and form a sort of connective tissue capsule around the clot, by this sequence of physiologic activities, a hemorrhagic cyst is developed. Such cysts are never lined with epithelium and usually contain coagulated blood or thin serous fluid with a small amount of fibrin. Hemorrhagic cysts, which are generally dark red or bluish, occur with few exceptions on the vocal cords. This is explainable by the fact that the vocal cords, more than any other part of the larynx, are subjected to traumatic injuries through overuse or misuse of the voice.

Laryngeal cysts of the mucous and hemorrhagic varieties are not true tumors, that is, they are composed of cells which fulfil no physiologic function. On the contrary, they represent the physiologic culmination of traumatic or inflammatory processes. Embryonic cysts in the larynx, on the other hand, are genuine neoplasms.

The etiology of these congenital cysts has attracted our attention. Many hypotheses have been advanced to explain their development. A number of years ago, Schneider² brought forth the hypothesis that such tumors arise from displaced embryonal cells which take part in forming the appendix of the ventricle, and Louys³ expressed the opinion that they are derived from the mesodermal tissue of the branchial arches. After considerable study, we are inclined to believe that Schneider's hypothesis is correct. A microscopic examination of the wall of the congenital cyst which we removed revealed a lining composed of stratified columnar epithelium containing mucous glands, whereas the subepithelial tissues were markedly infiltrated with lymphocytes (fig. 1).

At first the question arose in our minds as to the probability of this cyst's actually being a branchial cyst, since the larynx is formed from the fourth and fifth branchial arches. It would appear logical that a branchial cyst could occur as readily mesial to the thyroid cartilage as externally. Microscopically, both types of cysts bear some points of resemblance, since both may be lined with stratified columnar epithelium. However, in the walls of branchial cysts there are aggregations of lymphoid tissue that contains germinal centers. In our laryngeal cyst, no such lymphoid tissue was present, only an infiltration of lymphocytes was found. On comparing the wall of the cyst with the wall of the appendix of the ventricle, we found that there was great similarity. Since the laryngeal appendix in man is a functionless and degenerative

² Schneider, P, cited by New^{1a}

³ Louys, E, cited by New^{1a}

vestige of an important pouch in lower animals, it would not seem incredible that its development in the human being could be attended occasionally by the sequestration of some of its embryonal cells and that such cells, when segregated, could continue to multiply and eventually form a cyst. Then too, it is noteworthy that congenital cysts of the larynx always develop in close proximity to the laryngeal appendix, that is, in the lateral wall of the larynx or in the aryepiglottic fold



Fig 1—The wall of a congenital laryngeal cyst ($\times 50$). The lining is composed of stratified columnar epithelium and contains mucous glands. There is a lymphocytic infiltration in the subepithelial tissues.

Etiologically, one might consider a congenital laryngeal cyst analogous to inclusion dermoid cysts, which develop from inclusions of displaced dermal cells along the lines of embryonic fusion, such as the middorsal and midventral lines and the branchial clefts. In considering the situation from every angle, we find it most reasonable to assume that a congenital laryngeal cyst arises from cells sequestered from the embryonic cells which take part in forming the appendix of the ventricle

Although congenital laryngeal cysts have been observed in newborn infants, these tumors need not be present necessarily at birth. Some of them are first apparent in persons who have reached adult life. However, if small, these cysts may exist for many years without producing any noticeable symptoms. Generally their growth is extremely slow, but should one become infected its dimensions may increase with alarming rapidity.

There are no symptoms diagnostic of a congenital cyst of the larynx. Patients having such a neoplasm may complain of none, one, some or all of the following symptoms: dyspnea, hoarseness, cough, desire to clear the throat and a sense of fullness in the hypopharynx. But these signs and physical complaints are not characteristic of a specific kind of tumor, they are, in fact, typical of almost any laryngeal lesion.

The diagnosis must be based on visual inspection of the larynx. These cysts are confined to the lateral wall of the larynx or bulge into the aryepiglottic fold. A few penetrate the thyrohyoid membrane and expand into the neck. Usually they have a smooth, shiny, semitranslucent, tense and cystic appearance. Blood vessels course over the surface of some. When touched with a probe, they are compressible. The nature of such cysts, if situated deeply in the lateral laryngeal wall, may not be obvious, since the structures composing the lateral wall are merely pushed into the lumen of the larynx. Many congenital cysts that involve the aryepiglottic fold are of such large dimensions as to block completely a view of the glottis. With some such cysts it is amazing to observe the small amount of respiratory difficulty. This, of course, is based on the very gradual increase in the size of the cyst, which obstructs the larynx so slowly that the patient is entirely unaware of and becomes accustomed to the diminishing volume of air. Were the same degree of obstruction to occur within a few hours or days, the patient would require a tracheotomy as an emergency measure.

In most instances, the diagnosis is comparatively simple, although some of the cysts can be confused with other laryngeal lesions. A few years ago a patient was seen at the clinic with a smooth, rounded tumor involving the right aryepiglottic fold. On indirect laryngoscopic examination, the tumor appeared to be a cyst, but on further study it proved to be a lymphosarcoma. Congenital and mucous cysts deep in the lateral wall of the larynx or in the aryepiglottic fold can be identified only by microscopic examination. However, mucous cysts are uncommonly encountered in these situations.

The treatment of embryonal laryngeal cysts is dependent on their size and condition. When small they may be removed under direct laryngoscopy, the Lynch suspension apparatus being employed, but when large they can be exposed and excised only by means of thyrotomy. Patients who are severely dyspneic may require a preliminary trache-

otomy before any type of treatment is undertaken. When such a cyst is infected and contains purulent material, it may be advisable to incise it under suspension laryngoscopy, thus allowing its fluid contents to be expelled and permitting its walls to collapse. Frequently the cavity of the cyst subsequently will become obliterated by the formation of scar tissue. However, if the cyst tends to refill, it can be excised safely after the acute inflammatory reaction has subsided.

The first congenital laryngeal cyst seen at the clinic has been reported previously in our series of 722 cases of benign tumor of the larynx^{1b}. It occurred in a girl aged 14. Soon after her birth, stridor was noted. Hoarseness and dyspnea occurred later. When she was 7 the cyst was discovered, incised and drained several times, but there was no permanent relief of her symptoms. Examination at the clinic revealed a hemorrhagic mass in the right aryepiglottic fold. Under suspension laryngoscopy, the cyst was incised and drained, with evacuation of 1½ ounces (44 cc) of pus. Drainage was followed by healing, fortunately, and the patient has not had further trouble. Tissue was not obtained for microscopic study because the lining of the cyst had been destroyed by the infection, which had been present for years.

The second congenital cyst which we encountered did not cause symptoms and was not visible clinically. It occurred in a man of middle age who had an extensive epithelioma of the vocal cords. Situated deep in the left lateral wall of the larynx, the cyst penetrated the thyrohyoid membrane and bulged into the neck, much as in the first of the three cases described and illustrated by Davis⁴. This cyst was not discovered until its finger-like projection, external to the thyrohyoid membrane, was cut across while a laryngectomy was being performed for the removal of the malignant growth. Because of the small dimensions of the intralaryngeal portion of the cyst, it did not disturb the normal contour of the interior of the larynx sufficiently to make it noticeable on laryngoscopic examination.

The third congenital laryngeal cyst occurred in the following case.

A 17 year old girl had been hoarse since she was first able to talk. Because this symptom became progressively more severe, she finally consulted an otolaryngologist, who discovered a tumor in the hypopharynx. He advised her to come to the clinic as soon as her school term was ended. Accordingly, three months later, she registered in our section for consideration.

On indirect laryngoscopic examination, a large, smooth, rounded, tense and cystlike mass was found bulging the right aryepiglottic fold, involving the right wall of the larynx and extending into the right piriform fossa (fig 2). A view of the glottis was impossible because of the large size of the growth. With such a limited airway, it seemed remarkable that the patient did not complain of dyspnea.

⁴ Davis, E. D. D. Cysts of the Larynx, *J. Laryng. & Otol.* **38** 473-476 (Sept.) 1923.

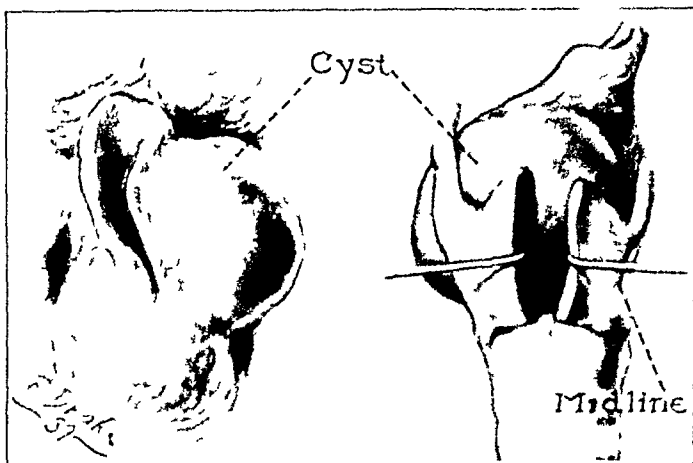


Fig 2—At the left, the congenital laryngeal cyst, as seen from its posterior surface. The cyst was situated deep in the right lateral wall, markedly bulged the right aryepiglottic fold so as to obstruct the supraglottic region of the larynx almost completely and extended into the right piriform fossa. At the right, the relative position of the congenital laryngeal cyst in relation to the epiglottis, the right aryepiglottic fold and the thyroid cartilage. The right lamina of the thyroid cartilage has been divided by a method similar to that carried out during the operation described.

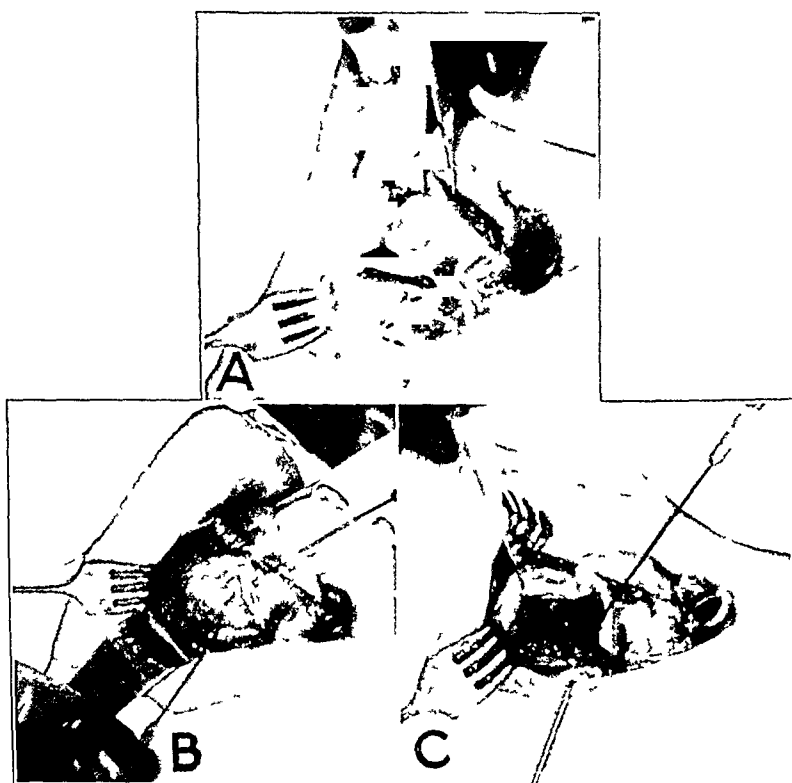


Fig 3—Photographs taken during the operation for the removal of the congenital laryngeal cyst. The patient's chin is at the left, and the tracheal tube is at the right. A, the tip of the forceps is in the thyroid notch, which lies in the median line. The right lamina of the thyroid cartilage has been divided for exposure of the cyst. B, the hooks retract the cut edges of the cartilage and expose the underlying cyst. C, the two hooks on the right retract the cut edges of the thyroid cartilage, the hook on the left retracts the thyrohyoid membrane. The cyst has been completely removed, and the large remaining pocket is visible.

A preliminary diagnosis of congenital laryngeal cyst was made with the recommendation that a tracheotomy be performed, to be followed by an exploration of the mass

Routine examinations of the blood and the urine gave essentially negative results, and her general physical condition was good. Roentgenologic examination of the cervical region showed some narrowing of the retrolaryngeal soft tissue space.

Four days after the patient's arrival, the trachea was opened just below the cricoid cartilage and a tracheal cannula was inserted. This procedure was absolutely necessary because of the large size of the growth, which undoubtedly would have obstructed the larynx completely during the subsequent manipulations employed in examining and removing the cyst.

Twelve days after the tracheotomy, the patient was anesthetized with nitrous oxide gas and ether, and a direct laryngoscopic examination was performed, the Lynch suspension apparatus being used. Even with this method for obtaining a direct view of the larynx, the cyst was entirely too large to allow visualization of the glottis. It was then decided that removal of the cyst under suspension laryngoscopy would be inadvisable and that a thyrotomy was indicated.

Consequently, after two days had passed a thyrotomy was undertaken. A cutaneous incision was made in the midline, and the right lamina of the thyroid cartilage was divided in a vertical direction, 1 to 2 cm to the right of the junction of the two thyroid laminae (fig 2 and 3 A). The cyst was exposed and was found to bulge above the thyroid cartilage (fig 3 B). By careful dissection, the surgeon removed the entire tumor without cutting through or into the mucosa of the larynx. At one point the cyst was accidentally nicked, and a thin whitish fluid was discharged. However, this rupture did not interfere with complete excision. No definite connection of the cyst with the ventricle or its appendix was discovered. The two portions of the thyroid cartilage were reunited with interrupted sutures of chromic gut, and the overlying skin was approximated with sutures of fine black silk. Two Penrose drains were inserted, one was arranged above the thyroid cartilage so as to extend into the pocket formed by the removal of the cyst (fig 3 C), and the other was placed lateral to the right lamina of the thyroid cartilage.

The patient made an uneventful recovery and was discharged from the hospital nineteen days later, with the tracheal tube removed. After another three days, she was dismissed from the clinic. The hoarseness entirely disappeared, and the internal aspect of her larynx became perfectly normal.

TREATMENT OF OTITIC MENINGITIS

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For many years meningitis has been accepted as one of the complications of purulent disease of the middle ear, and it is one of the most dreaded complications which may follow any surgical procedure. Since a really scientific interpretation of disease of the middle ear and mastoid has been recognized, attempts at treatment and cure of meningitis have been pathetically disappointing. The entire gamut of surgical, medical and chemical procedures has been tried, and temporary enthusiasm has given way to extreme pessimism as statistics showed that no progress was being made. The one exception is that radical surgical intervention plus spinal drainage seemed to give a few cures, extremely few on the basis of percentage. Gray surveyed the literature from 1901 to 1935 and collected 2,200 cases of otitic meningitis with only 66 recoveries, a mortality of 97 per cent. Neal, in the New York Department of Health, collected 238 cases from 1910 to 1935, with a mortality of 95 per cent. (This, by the way, was the best showing of cures in any series reported.) From 1920 to 1935, at Johns Hopkins Hospital, not a single patient with otitic meningitis recovered. At the Manhattan Eye, Ear and Throat Hospital, from 1926 to 1936, 101 cases of meningitis were reported, with 2 recoveries, a mortality of 98 per cent.

It is my intention to describe the treatment and results in 14 consecutive cases of otitic meningitis and 1 case of meningitis following submucous resection in which admission was made to my service at Queens General Hospital during the past two years. Only the cases in which the organism was actually recovered in the spinal fluid are reported. In this series, treatment was comparatively similar in each case, namely, a combination of radical surgical intervention, daily spinal drainage and the intensive use of sulfanilamide or one of the related compounds. Clinical adjuncts, such as blood transfusions and intravenous administration of dextrose were employed during the same period.

TREATMENT

1 *Surgical Procedure*—After a thorough simple mastoidectomy was performed, the dual plate over the temporal lobe was removed, the diameter of the bone removed in the average case was approximately

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1½ inches (4 cm) The wound was filled with a 70 per cent solution of alcohol, which was allowed to remain in it for about two minutes The cavity was then dried and the dura slit with three or four parallel incisions, free flow of the spinal fluid thus being allowed The external ear was sutured forward and a doughnut dressing applied behind it, so that when pressure was applied during the bandaging the cutaneous surface could not adhere to the incisions in the dura and free drainage was thus not interfered with

2 *Palliative Measures*—On the patient's return to his room the foot of his bed was elevated 18 inches (46 cm), and continuous intravenous administration of a 10 per cent solution of dextrose by means of the old-fashioned Murphy drip was maintained for several days to prevent dehydration As many transfusions were given as deemed necessary for the patient's general condition, probably an average of six in each case, the amount of blood depending on the age of the patient Daily spinal taps were done to flush out the meninges, to reduce the pressure of the spinal fluid and to examine it for organisms and cell count

3 *Sulfanilamide Therapy*—Sulfanilamide and neoprontosil were given in intensive doses, by mouth, intramuscularly and intraspinally, the dose of each depending on the age and weight of the patient In the use of sulfanilamide and neoprontosil it is important to produce a high concentration of the chemotherapeutic drug in the blood as soon as possible and to maintain this concentration as long as necessary Therefore, during the first forty-eight hours, it is my custom to administer the drug to the limits of tolerance, and at the end of that time, as a rule, the amount is cut down, as the acute symptoms have somewhat subsided Absorption of the drug is rapid, as sulfanilamide, the form given by mouth, is almost completely absorbed in four hours, and therefore the drug should be given orally within four hours It takes about forty-eight hours to obtain its maximum therapeutic effect After the first forty-eight hours, the dose was cut down, but no matter how well the patient seemed small doses were given for at least one month

In several of the cases to be reported, the spinal fluid was sterile for days, and unexpectedly the organism reappeared Therefore, one should not stop giving the drug altogether for at least one month

Dosage As the condition in all the cases was severe, the doses were large at all times During the first forty-eight hours, adults weighing 120 pounds (54 Kg) or over received 1 cc of neoprontosil for each pound (0.5 Kg) of body weight per day, i. e., 20 cc of neoprontosil each four hours, and, in addition, 20 grams (1.3 Gm) of sulfanilamide by mouth each four hours and 0.8 Gm of sulfanilamide powder in 100 cc of saline solution injected into the spinal canal once or twice a

day according to the severity of the illness. The more spinal fluid withdrawn, according to the pressure, the more sulfanilamide solution was injected.

After the first forty-eight hours, if the patient showed improvement, the dose was cut down, if not, the same dose was kept up for twenty-four to forty-eight hours more. For children the dose was cut down according to their weight, regarding 120 pounds (54 Kg) as the adult weight.

If oral administration alone was used, much larger doses were given, even as high as 50 to 80 grains (3.2 to 5.2 Gm) for the initial dose, followed by 20 grains (1.3 Gm) each four hours, for a person weighing 100 pounds (45 Kg) or more.

The drug seems to act best when administered orally, but when the patient is unconscious and cannot swallow the administration of neoprontosil, as well as the intraspinal medication, may be greatly increased.

Personally, I feel that the drug should be administered in all three ways.

I met with no untoward results except slight cyanosis, dizziness, nausea and tinnitus at times, and on reduction of the dose all cleared up.

Daily estimations of hemoglobin and leukocyte and differential cell counts were made. One of the dangers of too large doses of sulfanilamide is the production of hemolytic anemia. The hemoglobin content has been known to drop from 100 to 18 per cent in a few days, and some cases have been reported in which agranulocytosis followed the use of the drug. These conditions may come on at any time up to a week after its administration is discontinued, which makes it important to continue daily blood counts for a week or ten days after that time. The concentration of the drug in the blood can be readily determined at the present time, and it is important to do this frequently, as a greater concentration is required to control some infections than others. The average infection is controlled by a concentration of 8 to 10 mg per hundred cubic centimeters of blood. For a severe infection, such as meningitis, the concentration should be 15 mg. The amount which must be administered to attain a given concentration depends on the ease and rapidity with which a particular patient eliminates the drug. The fluid intake should be restricted to hasten the concentration.

BACTERIOLOGIC CLASSIFICATION

The bacteriologic agents in the present series of cases may be divided into four groups: (1) streptococcus, (2) pneumococcus, (3) staphylococcus and (4) *Bacillus influenza*.

Therapeutically and from the standpoint of prognosis, this grouping is important, as by far the best results were attained with the strepto-

coccic infections, from which 7 of 8 patients recovered. With the pneumococcic infections, on the other hand, 3 of 5 patients died. Unfortunately, these cases came under observation before sulfapyridine (2-[paraminobenzene sulfanimido]-pyridine) came into existence.

One patient infected with *Staphylococcus albus*, 1 with *Pneumococcus* type IV and 1 with *Pneumococcus* type XXIX recovered. One infection in the series, which came under observation three months ago, was caused by the B influenzae. The patient was treated with a combination of sulfanilamide and sulfapyridine and recovered.

I should like to report a typical case of infection with *Streptococcus haemolyticus*, as it illustrates the necessity of surgical intervention in some cases. There were 4 such cases in the series, in which I believe the patients would not have recovered with the use of sulfanilamide alone, as clinically and by bacteriologic tests they failed to improve until surgical treatment was instituted, after which the change was so marked that it seems impossible to consider it a coincidence.

CASE 1—A boy aged 8 years was admitted to the hospital on Jan 28, 1937, with acute mastoiditis on the right. Simple mastoidectomy was done on February 1. He was discharged from the hospital on February 9. He did well at home for two weeks, then palsy of the right external rectus muscle developed, accompanied by a temperature of 103 F. He was readmitted to the hospital the following day, complaining of a general headache and pain in the ear.

At the physical examination the child appeared acutely and critically ill, with a temperature of 105 F, a stiff neck, double Kernig signs and pallor of both optic disks. The spinal fluid contained 820 cells, with 65 per cent polymorphonuclears, and yielded a positive culture for *Str. haemolyticus*. Administration of sulfanilamide in large doses, by mouth and intramuscularly, was started at once, on February 24.

The patient remained acutely ill for the following three days, with a temperature of 105 to 106 F, severe headache and palsy of the external rectus muscle. On February 27 the petrous apex was explored, but a fistulous tract or other evidence of pathologic change could not be found. Postoperatively the temperature remained septic, ranging between 101 and 105 F daily. Repeated blood cultures were negative. This continued until March 10, when the lateral sinus was exposed for possible sinus thrombosis. It appeared normal and was not opened. The child continued to do badly, having an irregular temperature curve. The palsy of the rectus muscle and the ptosis remained almost the same, meningeal signs were increased, nuchal rigidity was more marked, and a 4 plus Kernig sign was present. The spinal fluid continued to be cloudy, with a high cell count and hemolytic streptococcus still present. This condition prevailed in spite of intensive sulfanilamide and neoprontosil therapy. Numerous intravenous infusions of a 10 per cent solution of dextrose and four blood transfusions of 300 cc each were given. Spinal taps were done daily to relieve the pressure. Culture of the spinal fluid was positive every day. The child continued to decline, and the situation appeared desperate.

On March 29, thirty-three days after the second admission to the hospital, he was again taken to the operating room, and the dura over the temporal lobe was

slit horizontally by three parallel incisions, each about $\frac{3}{4}$ inch (2 cm) long to allow for free drainage of the spinal fluid. The child was then placed in bed, the foot being elevated 18 inches (46 cm).

From this point on the child began to improve. The temperature curve began to flatten out, although it reached 101 or 102 F daily. The child seemed much improved clinically, with marked improvement in the palsy of the rectus muscle and the ptosis. He seemed to be less drowsy and took nourishment better. The spinal fluid rapidly cleared after the operation, and four days later the culture was negative for the first time, after twenty-four consecutive positive cultures, with a cell count of only 150 and the sugar content increasing.

The dural wound drained freely for several days. Herniation of the brain did not occur. Two months after operation the child's temperature was normal, and the wound had filled with granulation tissue. Culture of the spinal fluid was negative, and the only residue of the illness was slight spasticity of the lower right extremity. Administration of sulfanilamide in decreased doses was continued. On June 15 the child was discharged well.

The data on the spinal fluid throughout the illness were as follows:

Date, 1937	Culture	Cell Count
February 26	Positive, Str haemolyticus	820
February 28	Positive, Str haemolyticus	1,150
March 1	Positive, Str haemolyticus	2,680
March 2	Positive, Str haemolyticus	1,000
March 3	Positive, Str haemolyticus	1,640
March 4	Positive, Str haemolyticus	920
March 5	Positive, Str haemolyticus	1,118
March 6	Positive, Str haemolyticus	1,040
March 7	Positive, Str haemolyticus	2,135
March 9	Positive, Str haemolyticus	2,800
March 11	Positive, Str haemolyticus	1,060
March 15	Positive, Str haemolyticus	725
March 17	Positive, Str haemolyticus	1,010
March 18	Positive, Str haemolyticus	1,150
March 19	Positive, Str haemolyticus	930
March 20	Positive, Str haemolyticus	1,005
March 22	Positive, Str haemolyticus	725
March 23	Positive, Str haemolyticus	1,010
March 25	Positive, Str haemolyticus	1,450
March 26	Positive, Str haemolyticus	830
March 28	Positive, Str haemolyticus	760
March 30	Positive, Str haemolyticus	450
April 2	Sterile	220
April 5	Sterile	150
April 10	Sterile	105
April 15	Sterile	25

A resumé of this case strongly suggests that the various forms of sulfanilamide are insufficient to effect a cure, as was shown by the continuance of meningitic symptoms and the constant finding of hemolytic streptococcus in the spinal fluid. The real change for the better seems to have started immediately after decompression with dural slits to allow free drainage of the spinal fluid.

There were 4 deaths in the series, 3 caused by pneumococci and 1 by Str haemolyticus. The last followed the complication of an abscess of the temporal lobe, which unfortunately was not recognized in time. One infection with Pneumococcus type III, in which the course was rapid and fulminating, appeared hopeless from the beginning and termi-

nated fatally within forty-eight hours. The other 2 fatal infections were with *Pneumococcus* type I and had several points in common.

1 The onset and course were extremely rapid.

2 Local symptoms of danger were outwardly lacking, as the drum membrane appeared almost normal, sagging of the wall of the canal was not present and the usual symptoms of mastoiditis requiring surgical intervention were missing. Regardless of these findings, mastoidectomy revealed almost complete necrosis of the entire mastoid cavities, including the sinal and dual plates.

3 Death resulted in both cases even though intense surgical and medical endeavors were instituted.

At this time it seems logical to stress the importance of the newer drug, sulfapyridine, for it is well known that it is particularly efficacious against the pneumococcus group, and if it had been known at the time when these infections occurred it is easily possible that they too might have terminated in recovery.

REPORT OF ADDITIONAL CASES

CASE 2—E. B., a 4 year old girl, entered the hospital on March 16, 1937. Her past history was irrelevant. Two weeks prior to admission a high temperature suddenly developed, accompanied by headache and pain in both ears, which persisted up to the time of admission to the hospital. On March 10, 1937, six days before admission, the left ear spontaneously ruptured. Physical examination revealed an acutely ill child, with a temperature of 105 F, a pulse rate of 132, restlessness, severe headache, vomiting and stiffness of the neck.

The left ear drum was red, full and bulging, with the landmarks obliterated. Some dry exudate was present. Slight auricular edema was present, as well as suggestive tenderness over the mastoid. Myringotomy was performed and thick pus obtained. The right ear drum was injected but otherwise normal.

Neurologic examination showed definite nuchal rigidity, with positive Kernig and Babinski signs. Palsy of the sixth or seventh nerve and nystagmus were not present. A spinal tap revealed slightly opalescent fluid under a pressure of 250 mm of water, the cell count was 1,200, with 64 per cent polymorphonuclears and 36 per cent lymphocytes. No organisms were seen on smear, but culture showed *Str. haemolyticus*. The leukocyte count was 26,000, with 86 per cent polymorphonuclears, 10 per cent lymphocytes and 4 per cent transitional cells. Mastoidectomy was done on the left the same day. The cells were hemorrhagic, with occasional beads of pus. However, there was extensive softening and destruction of all the cells. The sinal plate was removed, and the sinal wall appeared healthy. The dura of the middle fossa was exposed during the operation. Culture of material from the mastoidectomy wound showed hemolytic streptococci. Large doses of sulfanilamide and neoprontosil were prescribed.

The following day, when the report on the culture of the spinal fluid was available, temporal decompression was performed, and the dura over the temporal lobe was slit in several places (three or four parallel incisions). For three days after operation the temperature ranged between 105 and 106 F, and then it gradually came down.

A resume of the case follows

March 16, 1937 admission to the hospital, simple mastoidectomy on the left, administration of sulfanilamide, two 5 grain (0.32 Gm) tablets each four hours for forty-eight hours, neoprontosil, 1 ampule each six hours, intramuscularly and sulfanilamide crystals, 0.8 Gm in saline solution, intraspinally, blood transfusion, 300 cc, continuous intravenous administration of 10 per cent solution of dextrose

March 17 operation uncovering temporal dura and making several slits in it, to allow free flow of spinal fluid, elevation of foot of bed 18 inches (46 cm), intravenous administration of dextrose continued, blood transfusion, 300 cc

March 18 reduction of dose of sulfanilamide to one 5 grain (0.32 Gm) tablet each four hours, administration of neoprontosil, 1 ampule each six hours, and of sulfanilamide crystals intraspinally continued

March 19 blood transfusion, 300 cc

March 21 absence of meningeal signs, headache and rigidity, temperature, 101 F

March 29 administration of sulfanilamide and neoprontosil in same doses continued

April 11 reduction of dose of sulfanilamide to one 5 grain (0.32 Gm) tablet each eight hours

May 5 patient discharged well

The data on the spinal fluid throughout the illness were as follows

Date, 1937	Culture	Cell Count
March 16	Positive, Str. haemolyticus	1,200
March 17	Positive, Str. haemolyticus	1,618
March 18	Positive Str. haemolyticus	2,100
March 19	Sterile	1,400
March 24	Sterile	1,200
March 27	Sterile	260
April 1	Sterile	10
April 4	Sterile	4
April 11	Sterile	4

Apparently the invasion of the meninges occurred at the outset of the illness, when the patient became suddenly ill, had a temperature of 105 F and complained of headache and pain in the ears. On the day of admission to the hospital, March 16, 1937, the patient had full-blown meningitis.

CASE 3—M S, a 24 year old white typist, unmarried, whose past history was irrelevant except for a miscarriage three years previously, was admitted to the hospital on March 18, 1937. Three weeks prior to her admission a cold associated with frontal headache and pain in the right ear had developed. The ear spontaneously ruptured and discharged up to the time of admission. The headache had become increasingly severe, radiating to the occipital region, in the past two weeks. The temperature ranged to 102 F. For the past two months the patient had been amenorrheic.

Physical examination revealed an acutely but not critically ill woman, with a temperature of 100 F, a pulse rate of 60 and a respiratory rate of 20.

In the right ear the hearing was impaired to perception of a whisper at 6 inches (15 cm) with a Barany noise apparatus in the left ear. The drum was reddened and edematous, with a scant thin discharge which did not reappear rapidly when wiped away. Sagging of the canal wall and tenderness over the mastoid were not present. The left ear revealed only redness of Shrapnell's membrane. Neuro-

logic examination on admission gave negative results. Meningeal signs, nystagmus and involvement of the sixth or seventh nerve were not present. The fundi were normal. The nose was normal, without polypi or pus. The heart and chest were normal. That afternoon the temperature rose to 103 F, and the patient appeared to be in a more toxic condition. In view of the history of a previous miscarriage, the vagina was examined. The cervix seemed soft, suggestive of Hegar's sign, and the fundus seemed enlarged. The possibility of a self-induced abortion with sepsis was entertained.

The next day, however, the temperature went to 105 F, with increased headache and stiffness of the neck. A spinal tap revealed cloudy fluid under increased pressure (500 mm of water), the cell count was 4,000, all polymorphonuclears. Culture showed type III pneumococci. The blood count was 20,000, with 97 per cent polymorphonuclears.

Simple mastoidectomy was performed on the right. A large pneumatic mastoid was encountered, all cells being necrotic and filled with granulation tissue, but no frank pus was found. Pathologic exposure was not noted. The wound was left open. Culture of material from the mastoid was reported to be sterile. Intensive sulfanilamide and neoprontosil therapy was initiated, but the next day the patient died. Autopsy showed mastoiditis on the right, purulent meningitis, pericardial effusion and local venous thrombosis, with myocarditis and congestive sphenitis.

The data on the spinal fluid were as follows:

Date, 1937	Culture	Cell Count
March 20	Positive, <i>Pneumococcus</i> type III	4,000
March 21	Positive, <i>Pneumococcus</i> type III	6,400

The bacterial findings in this case are interesting in that *Pneumococcus* type III, otherwise known as *Streptococcus mucosus encapsulatus*, while an extremely virulent organism, is nevertheless nonhemolyzing. Sulfanilamide is supposed to be most efficacious, or efficacious only, against hemolyzing organisms, and it is possible that had the organism been a hemolytic streptococcus or had sulfapyradine been available at the time the outcome might have been different. The history of pregnancy and amenorrhea unfortunately caused extreme confusion in the diagnosis and delay in surgical intervention.

CASE 4—W. H., a 7 year old white boy, on the day prior to his admission to the hospital complained of headache, vomiting and pain in both ears. The next day a punctate erythematous rash appeared over his body, and he was admitted to Queensboro Pavilion, the unit for contagious diseases of Queens General Hospital, with a conjectural diagnosis of scarlet fever, on March 24, 1937.

When first seen, he appeared moderately ill. Over the trunk and body the rash appeared. Both ears were red and full, with the landmarks obliterated. The tonsils were enlarged, with some cervical adenopathy, otherwise the physical examination gave negative results. A diagnosis of scarlet fever and bilateral acute purulent otitis media was made.

The child continued to have fever for ten days after admission. He had extreme tenderness over the left mastoid. Simple mastoidectomy was performed on the left. Free pus was present in the initial groove. Culture showed this to contain *St. haemolyticus*. There was moderate destruction of bone, especially in the zygomatic area. Pathologic or operative exposure was not recorded.

Postoperatively the child's temperature was elevated, ranging from 101 to 103 F. Tenderness over the right mastoid and aural discharges appeared. Seven days after operation palsy of the left external rectus muscle was evident. Roentgenograms of the petrous tips were reported normal.

On April 28 simple mastoidectomy was performed on the right. Free pus was found in the initial groove, and much cellular breakdown was present. The sigmoid sinus was exposed at operation. *Str. haemolyticus* was recovered on culture.

On May 1 the child had a chill, the temperature rose to 105.5 F, and he appeared acutely ill. A spinal tap was done, and a culture of *Str. haemolyticus* was reported, although neurologic signs were not present. Sulfanilamide and neoprontosil therapy was immediately instituted, 15 grains (1 Gm.) of sulfanilamide each four hours for the first forty-eight hours, followed by 10 grains (0.6 Gm.) each four hours, and 1 ampule of neoprontosil each six hours. Eight-tenths gram of sulfanilamide crystals in 100 cc. of physiologic solution of sodium chloride was injected intraspinaly at this time. A transfusion of 300 cc. of blood was given.

On May 5 the child complained of pain behind the eye. The petrous tips were submitted to an additional roentgen examination, which was reported as follows: There is a suggestion of diffuse rarefying osteitis in the apical portion of the left pyramid, but the findings are not sufficient to lend any degree of certainty to the diagnosis of petrous destruction.

On May 11 positive signs of meningitis were present, namely, stiffness of the neck, bilateral Kernig signs and transient ankle clonus on the left. The spinal fluid, on culture, revealed *Str. haemolyticus*. The dura of the temporal lobe was uncovered and slit in four places.

On May 15 the patient was much better, and the spinal fluid was sterile.

On May 22 the palsy of the rectus muscle was improved.

On May 29 the nuchal rigidity and other meningeal signs had disappeared. Administration of neoprontosil was discontinued, but the patient was still receiving sulfanilamide by mouth.

On June 2 a transfusion of 300 cc. of blood was given.

On June 5 the temperature was normal.

On July 4 the patient was discharged well.

The data on the spinal fluid throughout the illness were as follows:

Date, 1937	Culture	Cell Count
May 1	Positive, <i>Str. haemolyticus</i>	400
May 2	Sterile	240
May 3	Sterile	280
May 11	Positive, <i>Str. haemolyticus</i>	120
May 12	Positive, <i>Str. haemolyticus</i>	910
May 13	Positive, <i>Str. haemolyticus</i>	740
May 15	Sterile	12
May 20	Sterile	1,000
May 21	Sterile	2,400
May 26	Sterile	750
May 28	Sterile	102
June 2	Sterile	30

This case appears to be a repetition of case 1, sulfanilamide alone was not sufficient to effect a cure. Although the symptoms were temporarily abated, they recurred more intensely than ever ten days after the institution of sulfanilamide therapy, but they were promptly and permanently removed after temporal decompression with dual slits.

CASE 5—R N, a boy aged 8 years, was admitted to the hospital on April 4, 1937, with the following history: March 30, 1937, fever and earache on the left, March 31, spontaneous rupture of the left ear drum, April 1, elevation of temperature and cessation of drainage from the ear, April 3, pain in the left ear, myringotomy done by the family physician, followed shortly by severe generalized headache, vomiting and dizziness, April 4, admission to the hospital.

Physical examination revealed an acutely and critically ill boy, with full-blown meningeal signs, headache, stiffness of the neck, a temperature of 106 F, bilateral Kernig signs and definite nystagmus to the right. Palsy of the left external rectus muscle was present. The left ear had a red, full drum, with no landmarks, and a moderate thin and mucoid discharge, without tenderness over the mastoid. The patient was irrational, and it was impossible to ascertain the presence of hearing. A spinal tap yielded 60 cc of cloudy fluid, under pressure of 270 mm of water, with a cell count of 2,030, with 100 per cent polymorphonuclears. A smear showed gram-positive diplococci in chains. Culture revealed the organism to be *Pneumococcus* type I. The blood count was 15,050, with 88 per cent polymorphonuclears, 8 per cent lymphocytes and 4 per cent eosinophils.

Roentgen examination of the mastoid was attempted but was unsuccessful, because the patient could not cooperate.

The same day simple mastoidectomy with temporal decompression and slitting of the dura in several places was performed on the left. Frank pus was found in the initial groove, with complete necrosis of all mastoid cells.

The following therapy was instituted: intensive intravenous and intraspinal administration of antipneumococcus serum, 1,250,000 units in forty-eight hours, administration of sulfanilamide tablets, 15 grains (1 Gm) each four hours, and 1 ampule of neoprontosil each six hours, intraspinal injection of sulfanilamide crystals in saline solution, daily spinal taps, and repeated blood transfusions.

The child remained alive for thirty days, most of the time semicomatose and irrational, with a temperature ranging up to 105 F daily. The spinal fluid became sterile on four different days but did not remain so. The palsy of the rectus muscle disappeared. At no time was there more than a gleam of hope, and finally the child died, on May 3.

Twenty-four spinal taps were done during the patient's stay in the hospital, on twenty-three of these occasions the fluid was examined, and the data were as follows:

Date, 1937	Culture	Cell Count
April 4	Positive, <i>Pneumococcus</i> type I	2,030
April 6	Positive, <i>Pneumococcus</i> type I	3,215
April 7	Positive, <i>Pneumococcus</i> type I	800
April 8	Sterile	880
April 9	Positive, <i>Pneumococcus</i> type I	1,460
April 12	Positive, <i>Pneumococcus</i> type I	3,820
April 13	Positive, <i>Pneumococcus</i> type I	1,170
April 14	Positive, <i>Pneumococcus</i> type I	660
April 16	Positive, <i>Pneumococcus</i> type I	1,332
April 18	Positive, <i>Pneumococcus</i> type I	1,200
April 19	Sterile	1,000
April 20	Positive, <i>Pneumococcus</i> type I	2,000
April 21	Sterile	360
April 22	Sterile	460
April 23	Positive, <i>Pneumococcus</i> type I	2,448
April 24	Positive, <i>Pneumococcus</i> type I	360
April 24	Positive, <i>Pneumococcus</i> type I	1,300
April 25	Positive, <i>Pneumococcus</i> type I	1,830
April 25	Positive, <i>Pneumococcus</i> type I	1,826
April 26	Positive, <i>Pneumococcus</i> type I	1,270
April 27	Positive, <i>Pneumococcus</i> type I	270
April 28	Positive, <i>Pneumococcus</i> type I	1,476
April 29	Positive, <i>Pneumococcus</i> type I	1,152

To digress for a moment, it seems rather conclusive that the meningitic invasion was the direct result of the myringotomy, since nystagmus, vomiting and dizziness appeared almost immediately after the drum was opened.

This was 1 of 2 cases in the series in which the organism was *Pneumococcus* type I, in both of which mortality resulted regardless of treatment. It therefore seems that this organism must be regarded as an extremely fulminating one, but the outcome might possibly have been different had sulfapyridine been in use at the time.

CASE 6—A D, a 5 year old Italian girl, was admitted to the hospital on April 9, 1937, with a history of bilateral aural discharge of two and one-half weeks' duration. Examination revealed both drums red and bulging. A pulsating, thick discharge and suggestive sagging of the wall of the canal were present in the left ear. Tenderness over the mastoid was not present. The results of neurologic examination and those of physical examination other than the observations mentioned were negative. The urine contained albumin (2 plus) with many clumps of white cells. A diagnosis of bilateral acute purulent otitis media and pyelitis was made. During the next ten days the child had slight elevations of temperature, never over 101 F, and the urine cleared up. However, on April 19, ten days after admission, postauricular edema appeared on the right side. A profuse, thick, purulent discharge was present, which reappeared rapidly after being wiped away. There was definite sagging of the wall of the canal but still no tenderness over the mastoid. Roentgenograms revealed bilateral purulent mastoiditis with probable absorption of bone and perisinal abscess on the right side.

On April 19 simple mastoidectomy was performed on the right. At operation extensive destruction of the mastoid was encountered, with frank pus in the initial groove. The dura of the middle fossa and the sigmoid sinus was pathologically exposed. The sinus was uncovered from the knee to the tip. Bone over the dura was removed until healthy dura was encountered. The wound was packed with iodoform gauze and left open. A culture of pus from the mastoid was reported to be sterile.

Postoperatively the child did not do well. The temperature continued to be elevated, she appeared pale and washed out, in spite of several transfusions. The urinary abnormalities reappeared. Ten days after operation stiffness of the neck and body was noted, and a spinal tap was done, on April 29, revealing cloudy fluid under a pressure of 230 mm of water, containing sugar (1 plus) and globulin (2 plus), with a cell count of 4,280, with 91 per cent polymorphonuclears. No organisms were seen on smear, culture, however, revealed *Pneumococcus* type IV. Intensive sulfanilamide and neoprontosil therapy was instituted, but the child did not do well.

On April 30 the left mastoid was exposed and found to be normal.

On May 9 temporal decompression was undertaken, and dural slits were made.

The patient was subjected to daily spinal taps and several blood transfusions. The spinal fluid gradually cleared, the first sterile culture being reported on May 17, eight days after operation. On May 22 culture of the spinal fluid was positive again, but thereafter it was negative. Clinically, the child showed marked improvement, the meningeal signs disappeared in five days. The dural slits remained open for one week. On June 12 the child was discharged well.

The data on the spinal fluid throughout the illness were as follows

Date, 1937	Culture	Cell Count
April 29	Positive, <i>Pneumococcus</i> type IV	4,280
May 1	Positive, <i>Pneumococcus</i> type IV	4,100
May 3	Positive, <i>Pneumococcus</i> type IV	3,000
May 5	Positive, <i>Pneumococcus</i> type IV	1,300
May 7	Positive, <i>Pneumococcus</i> type IV	4,000
May 11	Positive, <i>Pneumococcus</i> type IV	2,600
May 13	Positive, <i>Pneumococcus</i> type IV	620
May 17	Sterile	850
May 19	Sterile	70
May 21	Sterile	120
May 22	Positive, <i>Pneumococcus</i> type IV	600
May 23	Sterile	840
May 24	Sterile	480
May 25	Sterile	75
May 29	Sterile	40
June 3	Sterile	12

This is the third case in which sulfanilamide in itself was not sufficient to effect a cure and to bring about the ultimate result. It was again necessary to resort to decompression and slitting of the dura

CASE 7—L. F., a 22 year old white man was admitted to the hospital on April 13, 1937 for submucous resection. He had had nasal obstruction as long as he could remember, present on both sides but more pronounced on the left. He used one handkerchief daily, his sense of smell was keen and he did not suffer from headaches. His past history was irrelevant.

General physical examination gave negative results. Examination of the nose revealed a sigmoid deviation, first to the left and then to the right in the region of the perpendicular plate of the ethmoid sinus impinging on the left middle turbinate. The airways were poor bilaterally, that on the left being limited to a small passageway along the floor. The mucosa was reddened and thickened and did not shrink well when sprayed with a 4 per cent solution of cocaine. Both anterior and middle tips were hypertrophied and somewhat polypoid. Frank pus and polypi were not present. The nasopharynx was normal. The throat contained small tonsillar tabs left after enucleation. The ears and the larynx were normal. Transillumination was easily accomplished. The sinusal plates were normal. Diagnoses of deviated septum and hypertrophic rhinitis were made.

On April 13 submucous resection was performed by one of the house surgeons. The anesthetic was a 10 per cent solution of cocaine sprayed into the nose under 25 pounds (11 Kg.) of pressure. The nose had first been washed with compound solution of sodium borate and the vibrissae cut. The usual Killian incision was made on the left and the resection performed without unusual difficulty or mishap except for a small perforation in the right flap about halfway back. The cartilage and bone were removed back to the rostrum of the sphenoid and down to the floor. The anterior tip on the left side was then removed with scissors and snare. On the right side the nasal snare broke so that a new wire could not be inserted. The procedure was completed with the use of a tonsil snare. The nose was packed with petrolatum gauze.

The next day the patient vomited and the temperature rose to 105 F. The packing was removed. The patient complained of severe frontal headache, and a spinal tap was performed. This revealed cloudy fluid under a pressure of 150 mm. of water. A smear showed 1,400 cells with 85 per cent polymorphonuclears. No organisms were visible on smear. Culture showed *Pneumococcus*

type XXIX. There was slight reduction with Benedict's solution. The sugar content was 61.7 mg per hundred cubic centimeters and the chloride content 756 mg. Sulfanilamide and neoprontosil therapy was immediately initiated, one ampule of neoprontosil each six hours, 3 tablets (15 grains [1 Gm]) of sulfanilamide each four hours being given. The patient received three blood transfusions of 500 cc each. Daily spinal taps were done, and the spinal fluid was replaced with a solution of 0.8 Gm of sulfanilamide crystals in 100 cc of physiologic solution of sodium chloride.

Clinically, the patient made an almost immediate response, his temperature dropped, and four days later it was normal. His headache rapidly cleared, and in a week he was free of meningeal signs. Spinal fluid cultures were positive until eight days after operation. Two weeks after operation the cell count was 9 per cubic millimeter, and reduction with Benedict's solution was normal. Administration of sulfanilamide was continued, however, 10 grains (0.6 Gm), and then 5 grains (0.3 Gm), each four hours, until the patient's discharge from the hospital on May 19.

The data on the spinal fluid throughout the illness were as follows:

Date, 1937	Culture	Cell Count
April 14	Positive, Pneumococcus type XXIX	1,400
April 15	Positive, Pneumococcus type XXIX	4,000
April 16	Positive, Pneumococcus type XXIX	3,800
April 17	Positive, Pneumococcus type XXIX	4,000
April 18	Positive, Pneumococcus type XXIX	7,776
April 19	Positive, Pneumococcus type XXIX	514
April 20	Positive, Pneumococcus type XXIX	3,210
April 21	Positive, Pneumococcus type XXIX	1,800
April 22	Sterile	260
April 23	Sterile	114
April 24	Sterile	180
April 26	Sterile	28
May 15	Sterile	3

An attempt at surgical decompression in this case seemed out of the question, as a proper point of decompression could not be ascertained. Consequently, it seemed necessary to rely entirely on such measures as administration of sulfanilamide, spinal taps and transfusions. This is the only case in this series in which decompression and dural slitting was not used.

CASE 8—D. M., a 9½ year old white boy, was admitted to the hospital on April 18, 1937, with a three days' history of earache on the right and full-blown meningeal signs. The ears revealed slight abnormality, Shrapnell's membrane was slightly injected on the right side. All landmarks were present. Because of the toxic, irrational state of the patient, the presence of tenderness over the mastoid was difficult to determine. The nose appeared clean. It was reported from Dr. Neal's laboratory that the spinal fluid contained Pneumococcus type I.

Mastoidectomy on the right side was done immediately. Extensive necrosis and softening of the right side was discovered, with pathologic exposures of the dura and sinus. Temporal decompression was done, and dural slits were made. Cultures of material from the mastoid showed Pneumococcus type I. Intensive therapy with antipneumococcus serum, neoprontosil and sulfanilamide was initiated, and several blood transfusions were given. In spite of these measures, the child rapidly declined, surviving for a week and dying on April 25, one week after admission to the hospital.

The data on the spinal fluid throughout the illness were as follows

Date, 1937	Culture	Cell Count
April 18	Positive, <i>Pneumococcus</i> type I	2,481
April 19	Positive, <i>Pneumococcus</i> type I	1,764
April 20	Positive, <i>Pneumococcus</i> type I	4,320
April 21	Positive, <i>Pneumococcus</i> type I	7,200
April 22	Positive, <i>Pneumococcus</i> type I	4,752
April 23	Positive, <i>Pneumococcus</i> type I	8,910
April 24	Positive, <i>Pneumococcus</i> type I	3,024
April 25	Positive, <i>Pneumococcus</i> type I	3,132

CASE 9—D C, a 4 year old white boy, was admitted to Queensboro Pavilion on April 18, 1937, with a diagnosis of measles and a discharge from the left ear. Examination showed the discharge from the left ear and tenderness over the mastoid, as well as indications of catarrhal disease of the right middle ear. During the patient's stay at Queensboro, his temperature decreased gradually from 105 F to 101. During this period he suffered an attack of bilateral acute ethmoiditis and swelling of the eyelids. The left ear continued to discharge, and the area over the left mastoid remained tender. Myringotomy was done on the right, and only a small amount of thin seropurulent discharge was obtained. On April 30 the boy was transferred to Queens General Hospital. The left ear now showed sagging of the wall of the canal and postauricular edema, the right ear had a mucopurulent discharge but no evidence of involvement of the mastoid.

On May 1 simple mastoidectomy was done on the left, with the finding of marked destruction in a large, well pneumatized mastoid. There were no pathologic exposures. On May 2, paresis of the left external rectus muscle was noted, and petrositis was suspected. On May 3, swelling was visible over the left anterior temporal region, but this subsided under wet dressings. The following day the temperature rose to 104 F, nuchal stiffness was present, and other signs of meningitic involvement were noticed. Spinal tap showed cloudy fluid, with a cell count of 4,000, which yielded hemolytic streptococci on culture.

On May 12, simple mastoidectomy was done on the right, and extensive destruction was found in the region of the solid angle, as well as exposure of the bulbar end of the sinus. On account of these findings and the meningeal manifestations, temporal decompression and incisions of the dura were added to the operation. The foot of the bed was elevated, and administration of sulfanilamide, neoprontosil and sulfanilamide crystals intraspinally was begun immediately. Culture of the spinal fluid was positive on nine consecutive days, until May 13, when it was sterile, and the patient improved steadily. On May 24 the spinal fluid was clear, with no globulin and about 180 cells. The mastoidectomy wounds healed cleanly, and only the left middle ear showed a slight discharge on the patient's return home. At the time of his discharge from the hospital, on June 14, the spinal fluid had been normal for one month.

The data on the spinal fluid throughout the illness were as follows

Date, 1937	Culture	Cell Count
May 4	Positive, Str haemolyticus	4,000
May 5	Positive, Str haemolyticus	3,150
May 6	Positive, Str haemolyticus	378
May 6	Positive, Str haemolyticus	2,160
May 8	Positive, Str haemolyticus	390
May 9	Positive, Str haemolyticus	2,140
May 10	Positive, Str haemolyticus	1,100
May 11	Positive, Str haemolyticus	940
May 13	Sterile	150
May 14	Sterile	640
May 16	Sterile	180
May 19	Sterile	60
May 24	Sterile	180
May 28	Sterile	12

This case is similar to cases 1, 2 and 4 in that all 4 were cases of invasion by hemolytic streptococci from which the patient ultimately recovered

CASE 10—E H was admitted to the hospital on May 1, 1938. At the time of admission the boy's right ear had been draining for six days. Three days prior to admission the temperature rose, and stiffness of the neck developed, accompanied by vomiting.

Physical examination revealed desquamation of the skin on the toes and fingers, postnasal discharge, discharge of thick pus from the right ear, nuchal and dorsal rigidity and bilateral Kernig and Babinski signs. The patient had received 40 grains (2.6 Gm.), 20 grains (1.3 Gm.) and 10 grains (0.6 Gm.) of sulfanilamide on the three days prior to admission. A spinal tap on admission showed cloudy fluid under increased pressure, with 2,800 cells. The dextrose content was reduced and the protein content increased. Seventy per cent of the cells were polymorphonuclears. Organisms were not seen on smear.

On May 3 mastoidectomy was done. Some necrotic bone was found. The dura was incised in two places, the wound was left open. One hundred and fifty cubic centimeters of citrated blood was transfused. The patient received sulfanilamide by mouth and neoprontosil and crystalline sulfanilamide intraspinally. Spinal taps were done daily. Culture of the spinal fluid taken on May 5 showed *Str. nonhaemolyticus*, the fluid contained 860 cells. On May 6 the spinal fluid contained *Str. nonhaemolyticus*, with 1,000 cells. Successive spinal taps showed continuous improvement.

The patient improved steadily, with no exacerbations. On June 23 he was discharged, with the ears dry and the mastoid healed. Residual neurologic abnormalities were not present.

A blood culture taken on May 2, 1938, was sterile. Culture of pus from the canal of the right ear on May 1, 1938, showed *Staphylococcus aureus haemolyticus*.

Sulfanilamide was given as follows: 20 grains (1.3 Gm.) on admission, 5 grains (0.3 Gm.) each three hours, eight doses in twenty-four hours, for seven days, then 5 grains each four hours for one day and then three times a day, and 15 cc. of an 8 per cent solution of crystalline sulfanilamide, intraspinally on May 3 and May 8. Transfusions of 150 cc. of citrated blood were given on May 3 and May 14, 1938.

The patient was discharged well on June 23. The data on the spinal fluid throughout the illness were as follows:

Date, 1938	Culture	Cell Count
May 5	Positive <i>Str. nonhaemolyticus</i>	860
May 6	Positive, <i>Str. nonhaemolyticus</i>	1,000
May 7	Sterile	30
May 8	Sterile	

CASE 11—A M K, a girl aged 8 years, was admitted to the hospital on May 10, 1938. The child had a cold two weeks prior to admission, three days before, the left ear began to discharge. The neck then became stiff. On the day of admission delirium and disorientation ensued, accompanied by vomiting.

Physical examination revealed an acutely ill child, with a moderately thick discharge from the left ear, redness and fulness of the drum, no sagging of the canal wall, apparent tenderness over the tip of the mastoid and stiffness in the neck.

A spinal tap showed cloudy fluid, with 2,500 cells per cubic centimeter, no sugar and a 4 plus reaction for globulin

On May 10 the patient was taken to the operating room, necrotic cells were found in the zygoma

The dura over the antrum was pathologically exposed and necrosis and free pus were found in the tip. A temporal decompression was done. On May 12 spinal fluid was reported to contain *Str. haemolyticus*. The child was taken to the operating room again, and dural slits were made, with escape of cloudy spinal fluid.

The child was subjected to transfusions, daily spinal taps and administration of sulfanilamide and neoprontosil, the latter intramuscularly and intraspinaly.

On May 17 the temperature came down to normal, and it remained so. On June 3 plastic closure of the postauricular wound was done. Recovery was uneventful. The patient was discharged on June 6 to the outpatient department, which she attended from June 8 to June 25, when she was discharged, with the postauricular wound healed and the middle ear dry.

The data on the spinal fluid throughout the illness were as follows

Date, 1938	Culture	Cell Count
May 12	Positive, <i>Str. haemolyticus</i>	2,300
May 13	Positive, <i>Str. haemolyticus</i>	1,450
May 14	Sterile	240
May 16	Sterile	30

CASE 12—D. T., a man aged 41, was admitted to the hospital on March 3, 1938, with a history of a cold, beginning two weeks prior to admission and followed in a few days by earache on the left. Eight days prior to admission the ear began to discharge. On the night before admission severe headache ensued. On the morning of admission the patient refused food, vomited and showed signs of irritability. Convulsions or coma were not present.

Physical examination revealed an acutely ill patient, complaining of left hemi-crania, with exquisite tenderness over the mastoid. The left ear had a full drum and a scant, thin discharge through a central perforation, without sagging of the wall of the canal. Mild nuchal rigidity was present, other observations were negative. A spinal tap revealed cloudy fluid under pressure with 800 cells per cubic millimeter, without sugar and with a 1 plus reaction for globulin. Organisms were not seen on smear.

On March 3 mastoidectomy was done on the left. Necrotic cells filled with pus, found in the tip and deep under the horizontal canal, were cleaned out. Pathologic exposure of the sinus, which was enlarged, and of the dura was present. After operation the patient received infusions and sulfanilamide therapy. The mastoid pus contained *Str. haemolyticus*. A culture of the spinal fluid was sterile. The patient did well for seven days, with the spinal fluid clearing, and then complained of headache again. A spinal tap revealed 2,200 cells per cubic millimeter. The fluid cleared rapidly, however, with repeated taps and administration of sulfanilamide, so that the patient was discharged on March 18 to the outpatient department for dressings.

He attended the outpatient department from March 22 to April 2. Good progress was noted, granulations were forming in the mastoidectomy wound. The middle ear continued to drain however.

On April 6 the patient was admitted again, he complained of frontal headaches and fever of two weeks' duration.

Physical examination revealed a thick pulsating discharge from the left ear and profuse drainage from the mastoidectomy wound. In spite of the absence of meningeal signs, a spinal tap was done, revealing 450 cells per cubic millimeter and *Str. haemolyticus* on culture.

On April 7 the mastoidectomy was revised and the dura slit for drainage. No focus of infection was found, the sinus was inadvertently opened and was packed off. The patient continued to do badly. He was comatose, with stiffness of the neck and a temperature of 103 F. On April 10 the operation was repeated, a lead was found under the facial canal, going in the direction of the petrous tip. It was cleaned out and enlarged, and more dural slits were made. Culture of the spinal fluid yielded *Str. haemolyticus*, the cell count was 1,650. The patient was given blood transfusions.

Owing to the increased cell count of the spinal fluid and the increasing coma of the patient, another exploration was made, on April 11, for an abscess. A good-sized abscess was found in the left temporal lobe, 6 or 7 cc of pus evacuated and a Mosher drain inserted.

The patient died the next day, April 12.

The data on the spinal fluid throughout the illness were as follows:

Date, 1938	Culture	Cell Count
March 3	Sterile	800
March 10	Sterile	2,200
April 6	Positive, <i>Str. haemolyticus</i>	450
April 10	Positive, <i>Str. haemolyticus</i>	1,650

The patient apparently had an abscess of the temporal lobe from the beginning, which was not discovered until it was too late.

CASE 13.—F. K., a married man aged 33, had as his chief complaint the results of an accident on Sept. 5, 1938, when the automobile in which he was riding was hit by a truck. As a result of the collision, the patient was thrown against the door and hit his head against it. He recalled nothing from then on. His relatives stated that there was bleeding from the ears, more so from the right one. He vomited several times. On admission to the hospital one day later, after being transferred from Trinity Hospital, he was drowsy but conscious.

Physical examination revealed a drowsy patient, answering questions with difficulty, slow but conscious. Nuchal rigidity and a serosanguineous discharge from the right ear were marked. The skin on the right side of the face could not be wrinkled, the right half of the mouth also was paralyzed. The tongue was coated and deviated toward the left side. The reflexes and the Babinski sign were absent. The pupils reacted to light and were equal. The opinion was that cerebral contusion was present, with moderate subdural hemorrhage (left motor region) and fracture of the skull. The roentgen report on the skull was as follows: "Examination of the skull shows a long linear fracture on the right side. It extends from the squamous portion of the temporal bone, across the temporoparietal suture and directly upward to the vertex. There is another fracture, extending from the region of the foregoing fracture, across the temporosphenoid area and into the anterior portion of the parietal bone. The fracture lines are approximately 5 and 2 inches (13 and 6 cm.) in length, respectively. There is no depression or marked separation of the fragments (Sept. 7, 1938)."

A study of the cervical part of the spine did not show evidence of fracture or dislocation. In passing, it was noted that there was a fracture involving the zygomatic arch on the right side.

On October 5 mastoidectomy with decompression of the temporal bone was done on the right. As the skin was retracted it was noted that there was a fracture extending from the zygoma up about 1 inch (2.5 cm), then across, over the squamous portion of the temporal bone, for another inch (2.5 cm) and then horizontally for $1\frac{1}{2}$ inch (4 cm).

After the cortex was removed, it was noted that there were spicules of bone going into the dura along the line of fracture.

The cells of the initial groove were gouged out, and as the operation proceeded toward the zygoma marked destruction was noted, and immediately a large-sized cavity was entered, which had exposed the dura. The cells of the zygoma were thoroughly cleaned out, and the semicircular horizontal canal presented itself, above and below it there seemed to be destruction of cells, these were cleaned out. The antrum was thoroughly cleaned out. Then the squamous portion of the temporal bone, from the zygoma up and around for about $2\frac{1}{2}$ inches (6 cm), was removed, and it was seen that the dura was dark, with some exudate. The squamous portion of the temporal bone was removed until healthy, normal dura was found. The cells over the sial plate were cleaned, the dural plate was removed for at least 1 inch (2.5 cm), and the tip was cleaned. A 95 per cent solution of alcohol was then put into the wound for several minutes. Gloves and gown were changed, and a new knife was used to nick the dura, horizontally, for about $\frac{1}{2}$ inch (1.3 cm). The wound was left open and dressings applied.

The patient was discharged on December 23. He was seen on December 30, the paralysis of the facial nerve was clearing up, and the wound closing over. On Jan 1, 5, 10, 15 and 30, 1939, the general condition was good, the wound was practically healed, except for a small opening. On February 15 the wound still had an opening, about the size of a pea, the paralysis of the facial nerve was clearing up. On March 3 the wound was closed and the paralysis of the facial nerve was better.

The data on the spinal fluid throughout the illness were as follows:

Date, 1939	Culture	Cell Count
September 10	Positive, Staph. albus	3,850
September 12	Positive, Staph. albus	2,800
September 16	Sterile	1,420
October 9	Sterile	600
October 14	Sterile	240
October 20	Sterile	150

CASE 14—A. G., a boy aged $5\frac{1}{2}$ years, was admitted to the hospital on Jan 29, 1939. Two nights before admission the patient complained of pain in the right ear. The temperature was 102 F. The next morning the pain in the ear was worse, and at night the temperature was 106 F, with nuchal rigidity, and the child was admitted to the hospital.

Physical examination showed the right ear drum at the time of admission red and bulging. Landmarks were not visible.

Myringotomy was done, and a mixture of blood and pus was obtained. A culture of this discharge contained *Staphylococcus aureus* and *B. influenzae*. The left drum was catarrhal. Full-blown signs of meningitis were present.

A spinal tap revealed fluid under increased pressure, 40 cc of cloudy fluid was removed, it contained 4,840 cells and yielded gram-positive bacilli on smear. Culture showed *B. influenzae*. Roentgen examination of the mastoid revealed diffuse haziness throughout the right side. No destruction of cellular walls was noted.

Mastoidectomy was then done on the right. The mucous membrane throughout was extremely hemorrhagic, frank pus was not encountered, the cells in the zygoma were softened. On the day of admission, the patient received 20 grains (13 Gm) of sulfanilamide, with the dose repeated in one hour, and then 10 grains (06 Gm) every four hours.

Postoperatively the patient was subjected to two spinal taps daily, with anti-influenza serum given intrathecally at each tap (eight times in all). Twenty grains (13 Gm) of sulfapyridine and 10 grains (06 Gm) of sodium bicarbonate were then given every four hours, and continuous intravenous administration of a 10 per cent solution of dextrose in a saline solution was carried out. The patient received daily small transfusions. The temperature on the day of operation varied between 103 and 105 F, the next day it fell from 105 to 99, but on the next day it returned to 105. The patient was stuporous, his condition was poor, and he was jaundiced. Postoperatively he was kept in the Trendelenburg position, and the flow of spinal fluid from the mastoidectomy wound was fairly copious. The drainage persisted freely for about forty-eight hours. The temperature on the day after operation varied between 103 and 105 F but on the next day started to decline, the patient was slightly more alert. The temperature subsided in the next four days to normal, at which it remained, the cell count of the spinal fluid dropped consistently and steadily. Recovery thereafter was uneventful.

Administration of sulfapyridine in the original dose was continued until February 17, when the dose was cut to $7\frac{1}{2}$ grains (05 Gm) three times daily. On February 27 all medication was stopped.

On March 1 the child was discharged. He has returned for observation at weekly intervals and looks well at the time of writing. The wound was practically closed without evidence of herniation or discharge on March 14.

The data on the spinal fluid throughout the illness were as follows:

Date, 1939	Culture	Cell Count
January 29	Positive, B influenzae	4,840
January 30	Positive, B influenzae	3,650
January 31	Positive, B influenzae	2,100
February 2	Positive, B influenzae	2,350
February 3	Positive, B influenzae	1,960
February 5	Positive, B influenzae	2,260
February 9	Sterile	1,350
February 12	Sterile	680
February 14	Sterile	920
February 16	Sterile	50

CASE 15—V S, a girl aged 8, was admitted to the hospital on Feb 14, 1939, with a history of earache on the left for seven days and a purulent discharge for three days, following acute infection of the upper part of the respiratory tract. Some tenderness was present over the left mastoid. Simple mastoidectomy was done on the left on February 25, because of the tenderness over the mastoid and the purulent aural discharge, with a temperature of 100 to 104 F and roentgen signs of mastoiditis.

The operative findings were reported as pus welling up on the making of the initial groove, pneumatic and extensive cells and pus in the retrosinal and zygomatic cells. Culture of material from the mastoid revealed *Str. haemolyticus*. The postoperative course was uneventful. The patient was discharged on March 6 to the outpatient department, where the wound was dressed.

Because of a fistula at the upper angle of the wound, the child was readmitted on March 25. On March 27 the mastoidectomy was revised, a few cells in the

zygoma and the tip were cleaned out. Profuse drainage, frontal headache on the left, diplopia and palsy of the left external rectus muscle were noted. Petrositis on the left was reported as shown on a roentgenogram taken on April 7. The temperature was 102 or 103 F. A spinal tap done on April 8 showed cloudy fluid under 200 mm of pressure, with 3,200 cells (mainly polymorphonuclears) per cubic millimeter, which yielded a positive culture for *Str. haemolyticus*. Organisms were not seen on smear, stiffness of the neck or a positive Kernig sign was not present.

On April 8 a third operation, revision of the mastoidectomy, exposure of the dura and modified radical mastoidectomy, was done. The dural plate of the middle fossa was soft, the dura looked fairly normal. A small area of soft necrotic bone posterior to the horizontal semicircular canal was found and curetted toward the petrous apex. The soft bone extended inward about 0.5 cm. The postoperative condition was poor. The patient received 250 cc of blood and 600 cc of a 5 per cent solution of dextrose in a saline solution. On March 4 the patient began to receive sulfanilamide (with sodium bicarbonate), 45 grains (2.9 Gm) and then 10 grains (0.6 Gm) every four hours. A spinal tap on March 9 showed 120 mm of pressure and a cell count of 1,100 per cubic millimeter and yielded a culture containing *Str. haemolyticus*. Another tap showed 900 cells, mostly polymorphonuclears.

On April 10 radical mastoidectomy was done, with almost complete removal of the tegmen of the mastoid and middle ear, a large cavity was made into the petrous pyramid below the canals, and the canals were skeletonized. A culture of the spinal fluid contained *Str. haemolyticus* on two occasions. Organisms were not seen on smear, the fluid did not contain sugar, the protein content was increased.

Treatment, in addition to the operations, consisted of administration of sulfanilamide (with sodium bicarbonate), daily blood transfusions and daily spinal taps. On April 9, 1939, the dose of sulfanilamide was 45 grains (2.9 Gm) and then 10 grains (0.6 Gm) every four hours, on April 10, 95 grains (6.2 Gm) and then 20 grains (1.3 Gm) every four hours, and for eight days subsequently, the same (120 grains [7.8 Gm] daily), with 5 cc of neoprontosil every four hours added on April 14. On April 18 the dose was cut to 5 grains (0.3 Gm) every four hours, which the patient was receiving on April 21.

Two hundred cubic centimeters of blood were given on April 8 and April 9, 1939, and then 75 cc daily.

The temperature is normal at the time of writing, and the child looks fairly well and has no complaints. The spinal fluid was sterile on April 19, with 350 cells, and she seemed on the road to recovery.

On April 25 she was out of bed and doing nicely.

On May 10 she was discharged well.

The data on the spinal fluid throughout the illness were as follows:

Date, 1939	Culture	Cell Count
April 8	Positive, <i>Str. haemolyticus</i>	3,200
April 9	Positive, <i>Str. haemolyticus</i>	1,100
April 10	Positive, <i>Str. haemolyticus</i>	10,000
April 11	Positive, <i>Str. haemolyticus</i>	14,000
April 19	Sterile	350
April 22	Sterile	120

CONCLUSIONS

In this series of 15 consecutive cases of meningitis, 11 patients recovered and 4 died giving a mortality of 27 per cent.

Sulfanilamide, while obviously extremely important, is apparently not sufficient in itself to produce a cure

Surgical intervention in itself is not sufficient, and it seems that a combination of the two, namely, sulfanilamide and surgical intervention offers the best hope

In the use of the drug, it is important that treatment be started early, that the dose be large and that the treatment be continued for several weeks after cessation of symptoms

Surgical measures likewise should be instituted as soon as the diagnosis is made

In 7 of 8 cases in which the invading organism was *Str. haemolyticus* the patient recovered. In 2 cases in which the organism was *Pneumococcus* type I and 1 case in which the organism was *Pneumococcus* type III the patient died

Had sulfapyridine been known when the pneumococcic infections were treated, the results might have been better

Six patients showed paralysis of the external rectus muscle

While I realize that this is not a large series of cases, it seems, nevertheless, that with the use of sulfanilamide plus surgical intervention meningitis is not necessarily to be considered so formidable as formerly

My associate, Dr. A. A. Cirillo, cooperated in the handling of the cases, and the residents, Dr. P. Lefkowitz and Dr. E. M. Hipsch, worked up the series

ABSTRACT OF DISCUSSION

DR. WELLS P. EAGLETON, Newark, N. J. I wish to call attention to certain facts about the cure of meningitis that have long been known but apparently today are being disregarded

I disagree with Dr. Cunning as to meningitis having been always fatal, for I would point out that before we had sulfanilamide, I cured 27 patients with bacteria in the spinal fluid. With all cases of meningitis taken together, my percentage of recoveries was 32.

Examination of patients with bacteria in the fluid who were cured without the use of sulfanilamide taught certain facts that help to explain why patients are cured today when treated with sulfanilamide and why certain of them relapse.

All the patients who recovered were cured by removal of all foci of infection in the bone or vessel and because the bacteria in the spinal fluid were attenuated, of low grade virulence or few. Contributing factors were that the sugar content of the cerebrospinal fluid was maintained, although the patients often were acutely ill, and that the infection had lasted a sufficient time to allow protective meningitis to develop. Several of the infections which I cured belonged to the specific self-limiting type, which I have named toxic and allergic overflow meningitis from scarlet fever or from pneumonia.

The presence of sugar in the cerebrospinal fluid signified that the normal metabolic action of the brain had not been interfered with, although the meninges were the seat of a bacterial infection, the metabolic action of the central mechanism continued. This is exactly what takes place from the use of sulfanilamide. The drug acts in a similar way, by causing bacteriostasis, thus

preventing the bacteria from paralyzing the metabolic mechanism of the brain. The relapses occur because sulfanilamide has a bacteriostatic action only on the bacteria that it can reach.

The case of death from abscess of the brain just reported is enlightening. It reminds me of one of my cases, in which a child apparently suffered from meningitis. A radical operation on the bone was done. He was given sulfanilamide. The spinal fluid rapidly cleared of micro-organisms, but the child did not get well.

A ventriculogram revealed the abscess in the occipital lobe, which was opened. The pus was full of streptococci, and yet the cerebrospinal fluid had been free from micro-organisms for many weeks, during which time the patient was given sulfanilamide continuously.

The presence of hemolytic streptococci in the abscess of the brain after sulfanilamide had sterilized the cerebrospinal fluid meant that sulfanilamide does not act in the presence of encapsulated or necrotic tissue even when in high concentration in the blood or cerebrospinal fluid. It cannot reach a localized area of infection or attack bacteria in areas of necrotic tissue.

Sulfanilamide acts best in the presence of fever, and in meningitis there is fever, but with abscess of the brain the temperature often is subnormal.

I would emphasize, as has Dr. Cuning, that, while this drug is a most wonderful remedy, one must be guided by the old surgical principles. In every case of otitic meningitis one must thoroughly explore and remove every possible focus of infection. A clinical diagnosis of the exact anatomic location of the foci of infection in the bone or vessels can be made in the vast majority of cases if a proper history is taken and can invariably be made when this study of the case is followed by complete surgical exposure of all possible tracks of infection from the bone into the meninges. This is possible only by a complete unlocking operation. To obtain the best results all localized foci of infection in or around the temporal bone must be drained, and if possible eradicated. The only satisfactory operative technic ever devised that fully exposes all areas of infection is what I call the "unlocking of the petrous pyramid."

The carotid artery should always be tied when the infection in the meninges comes from, or the advancing lesion is, thrombophlebitis of the carotid venous plexus.

The dura should be opened when it contains a localized focus adjacent to the primary focus in the bone, as in the vast majority of cases of otitic meningitis.

DR. BERNARD J. McMAHON, St. Louis. This interesting and carefully prepared paper has presented for consideration many significant points in the treatment of otitic infections and their complications.

Dr. Cuning has brought out the important point, that chemotherapy, serotherapy, transfusion and other adjunct treatment should be supplemented by the proper surgical intervention, which should not be inadvisedly postponed in the hope that the adjunct measures may accomplish the desired recovery.

Incisions of the meninges establish drainage not only from the intracranial cavity but from the meninges themselves. The meningeal drainage is important in releasing the inflammatory exudate in these membranes themselves about the perivascular lymphatics along which the infection has extended from the bone of the mastoid to the cranial cavity.

The indications for paracentesis or mastoidectomy remain unchanged.

The use of sulfanilamide will not and cannot obviate operative intervention in the presence of necrosis or cavitation within the cellular structure of the

mastoid process. The presence of the hemolytic streptococcus should be positively ascertained if possible before this medication in larger doses is started, and the dosage should be guided by the severity of the infection and subsequently adjusted according to the reaction of the patient. One should always bear in mind the numerous signs of sulfanilamide toxicity which have been repeatedly reported. The onset of these signs is not always in direct proportion to the dose, as many persons are particularly susceptible to the drug.

Dr. Converse has mentioned the importance of hemotherapy or serotherapy when the response to sulfanilamide therapy is inadequate, since without the timely mobilization of the phagocytic cells at the area of infection chemotherapy will be unavailing. Sulfanilamide can exert a bacteriostatic effect for only a certain length of time before toxic signs may develop, consequently, the adjunct treatments should be resorted to within the first forty-eight to seventy-two hours.

Sulfanilamide should not be administered unless the patient is kept in bed and under the careful and constant observation of his physician.

It is the duty of the physician to warn patients of the dangers of ill advised and uncontrolled administration of this drug, and one may hopefully look forward to the enactment of legislation in every state prohibiting the sale of sulfanilamide, sulfapyridine and their allied products by the druggist without a physician's prescription.

DR. A. A. CIRILLO, New York. I should like to stress 1 particular case in Dr. Cunning's series, which was observed recently at Queens General Hospital. A child 5 years of age was admitted on January 29 with influenzal meningitis. Culture and smear were positive. Simple mastoidectomy was performed and sulfapyridine, serum and sulfanilamide were administered. Because the child was getting worse Dr. Cunning suggested that a dural slit be made. The child had a temperature of 106 F. and a pulse rate of 136 and was jaundiced and comatose.

Two days later the temperature dropped to 98 F., and on March 3 the child was discharged as cured.

In a case of meningitis due to *Staph. albus* resulting from an automobile accident paralysis of the right facial nerve and hemorrhage from the right ear developed. *Staph. albus* was present in the spinal fluid and could be demonstrated on smear. It was noted in doing a decompression in this case that two spicules of bone had perforated the dura, this was evidently the avenue of infection. This patient, too, recovered.

DR. PIERRE VIOLE, Los Angeles. Apropos of the remarks of the essayist concerning the use of serum, I should like to stress its importance, particularly in the presence of infection with hemolytic streptococci. In Los Angeles some spectacular results have been obtained in such cases with the use of human convalescent scarlet fever serum obtained from the serum center at the Children's Hospital there. In view of the successes with this treatment, I think its use should be encouraged. I should be interested also in hearing reports from other medical centers where human convalescent serum has been used extensively.

INTRANASAL DACRYOCYSTOTOMY

W E SAUER, M D

ST LOUIS

Surgery of the lacrimal sac dates back to the time of Galen, 50 A D , and of Celsus,¹ 100 A D , but credit for the first intranasal dacryocystotomy is generally given to Caldwell,² of New York, who published his work in 1893 Ritter³ cited the work of Hopmann, who as early as 1885 brought forth the idea of operating on the lacrimal sac intranasally, using a sound passed from above as a guide Killian⁴ in 1889 reported his intranasal operation He passed a Bowman probe from above, carrying it down into the lacrimal canal as far as possible He then cut off the anterior end of the inferior turbinate and removed all the intranasal wall of the nasolacrimal duct Passow⁵ reported on 4 patients operated on by this method two years later In 1904 Strazza reported his intranasal operation and in 1908 Okuneff reported on a similar operation All these early workers removed a part of the inferior turbinate intranasally and then opened the nasolacrimal duct, working upward until a probe passed from above could easily be advanced into the nose Only Strazza continued his resection upward to include the tear sac, he applied the curet to its walls

However, it was West⁶ who put the intranasal operation on a firm basis His first publication appeared in 1909 It is interesting to follow the evolution of his technic In his first case he followed Killian's method—i e, the anterior part of the inferior concha was removed,

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1 Celsus, A C Of Medicine, in Eight Books, translated by J Greive, ed 3, London, E Portwine, 1837

2 Caldwell, G W Two New Operations for Obstruction of the Nasal Duct, with Preservation of the Canaliculi, and an Incidental Description of a New Lachrymal Probe, New York M J **57** 581, 1893, reprinted, Am J Ophth **10** 189, 1893, A New Operation for the Radical Cure of Obstruction of the Nasal Duct, New York M J **58** 476, 1893

3 Ritter, in Katz, L, and Blumenfeld, F Handbuch der speziellen Chirurgie des Ohres und der oberen Luftwege, Leipzig, Curt Kabitzsch, 1923

4 Killian, cited by Ritter³

5 Passow Zur chirurgischen, Behandlung der Verengerungen des Thränen-Nasenkanals, Munchen med Wchnschr **48** (pt 2) 1403, 1901

6 West, J M A Window Resection of the Nasal Duct in Cases of Stenosis, Tr Am Ophth Soc **12** 654, 1909

and the entire nasolacrimal duct was opened. Soon after that he⁷ began to save the inferior concha, he opened the nasolacrimal duct by making a window in the lateral nasal wall above the inferior turbinate. A probe was passed into the nasolacrimal duct from above to serve as a guide. The next step in the development of his operation came when he opened only the sac, the duct was left completely alone. The final improvement came when he began to excise all the wall of the sac except a small piece immediately around the opening of the canaliculi—the so-called intranasal total extirpation. Briefly, he elevated a small flap of nasal mucoperiosteum over the torus lacimalis and turned it down, then, by means of a chisel applied intranasally, he made an opening in the bone (including a part of the lacrimal bone and a part of the frontal process of the maxillary bone). Through this bony window he seized the wall of the sac (a probe having previously been passed in through the canaliculus to make tension on the wall) with a forceps and extirpated a part or all of it.

Polyak⁸ and Halle⁹ described a similar intranasal technique at about the same time. Polyak elevated a piece of nasal mucoperiosteum but did not save it. He made a wide exposure of the sac and then removed its entire nasal wall. It is interesting to recall that in 1902 Polyak¹⁰ had published a method of retrograde dilation of the nasolacrimal duct. He later abandoned this. Halle in describing his operation laid great stress on his flap of nasal mucoperiosteum, which he turned back. After the bony window was made and the sac opened, he completely severed the sac from the duct, the flap was returned to its original position and a small hole cut out of it to serve as a passageway for the tears. The remainder of the flap formed a sort of valve to prevent the blowing of air up into the conjunctival sac from the nose.

7 West, J. M. Tranentraufeln, *Deutsche med. Wchnschr.* **38** (pt 1) 779, 1912, Die totale Exstirpation des Tranensackes von der Nase aus mit Wiederherstellung des normalen Abflusses in Fällen von Dakryozystitis *Ztschr. f. Augenh.* **45** 159, 1921, Intranasal Lacrimal Sac Operation, *Arch. Ophth.* **55** 351 (July) 1926.

8 Polyak, L. Ueber das Eröffnen des Ductus nasolacrimalis im vorderen Teile des mittleren Nasenganges, *Ztschr. f. Augenh.* **27** 92, 1912, Ueber die intranasale Dakryocystotomie, *ibid.* **30** 557, 1913, Zwei Fälle Schussverletzungen der Nase, mit Verletzung des Tranensackes und Nebenhohlenerweiterung, *Internat. Centralbl. f. Laryng.* **34** 67, 1918.

9 Halle. Zur intranasalen Operation am Tranensack, *Arch. f. Laryng. u. Rhin.* **28** 256, 1914, Internasale Tranensackoperation bei einem Säugling von 3½ Monaten zur Entfernung einer hineingeglittenen Dauersonde. Die intranasale Tranensackoperation und ihre Erfolge, *Berl. klin. Wchnschr.* **55** 256, 1918, Die nasale Chirurgie der Tranenwege, *Ztschr. f. Laryng. u. Rhin.* **11** 60, 1923.

10 Polyak, L. Die Sondierung des Ductus nasolacrimalis von der Nase aus, *Arch. f. Laryng. u. Rhin.* **12** 379, 1902.

From that time (about 1911) on, a wealth of material on intranasal operations was published, the numerous operative procedures embraced the same principle, but each had some peculiarity of technic. A few of them will be described briefly. Choronshtitzky¹¹ passed a pointed metal sound through the punctum and canaliculus into the sac. He then forced this through the lacrimal bone into the nose and, using it as a guide, made a communication between the nasal cavity and the tear sac intranasally. Later he merely made a puncture through the lacrimal bone with the probe. He passed a thread through the tract and allowed it to remain for some time. In 1912 Dr W M C Bryan¹² reported a slight modification of West's operation. Glogau¹³ made use of Halle's technic but left a continuous thread in place for several weeks. In 1915 Hanger¹⁴ reported a technic essentially like Killian's. Rudolf Hoffmann¹⁵ slit the upper canaliculus and through it passed a sound larger than could otherwise have been used, pushing the tip through the lacrimal bone into the nose to guide him in making an intranasal opening between the nasal cavity and the tear sac.

The idea of a thread or bougie remaining in an opening between the tear sac and the nose is an ancient one, and numerous ingenious methods have been devised to accomplish this. Sir Percival Pott¹⁶ in the eighteenth century described an inlying leaden cannula and bougie, Andrew¹⁷ in 1883 recommended an inlying leaden stylet, Vulpius¹⁸ used an indwelling metal sound, leaving it in place for a year or more, Kyle¹⁹ inserted a removable silver cannula, which was cleaned and replaced by the patient from time to time, Koster²⁰ used a silk thread,

11 Choronshtitzky, B. Die perkanalikulare Tranensackdurchstechung als Einleitung zur intranasalen Tranensackeroeffnung und als selbständige Operation, *Arch f Laryng u Rhin* **28** 363, 1914

12 Bryan, W M C. Submucous Dacryocystorhinostomy for Persistent Dacryocystitis, *Ann Ophth* **21** 497, 1912

13 Glogau, O. A Case of Dacryo-Cysto-Rhinostomy, *Laryngoscope* **25** 28, 1915

14 Hanger, F M. An Intranasal Operation Without a Guide for the Cure of Dacryocystitis, *Laryngoscope* **25** 23, 1915

15 Hoffmann, R. Ueber Dakryocystorhinostomie, *Monatschr f Ohrenh* **48** 985, 1914

16 Pott, P. Of the Fistula Lachrymalis, in *Chirurgical Works of Percival Pott*, edited by J Earle, first American edition, from the last London edition, Philadelphia, J Webster, 1819, vol 1, p 179

17 Andrew, E. The Treatment of Lachrymal Obstruction, *Brit M J* **2**. 1185, 1883

18 Vulpius, W. Die Behandlung der Thranennasencanalstenosen, eine rhinologische Aufgabe, *Deutsche med Wchnschr* **22** 99 (pt 1), 1896

19 Kyle, J J. Operation Intended as Substitute for Extirpation of Lachrymal Gland or Duct, *Am J Ophth* **14** 369, 1897

20 Koster, W. Die permanente Drainage der Tranenabflusswege, *Arch f Ophth* **67** 87, 1907

Burdon-Cooper²¹ used silk-worm gut, Van Lint²² used rubber tubing, and as recently as 1936 Spratt,²³ of Minneapolis, recommended the use of a hollow metal tube

Yankauer²⁴ suggested that the nasolacrimal duct acts like a siphon. Working intranasally, he elevated the nasal mucoperiosteum over the duct, resected its bony wall and slit the entire membranous canal from its nasal opening, up to and including the sac. Then he replaced the nasal mucoperiosteal layer. The result was an enlargement of the bony membranous passageway and the reestablishment of drainage in the natural manner. Naturally the anterior part of the inferior concha was sacrificed during this operation.

Horgan²⁵ always performed submucous resection of the septum before going ahead with intranasal dacryocystostomy (West type). Blegvad²⁶ did an intranasal operation similar to that of West, except that he used an electric drill rather than a chisel to go through the bone. In 1920 Bookwalter²⁷ reported an intranasal procedure essentially the same as West's. Affolter²⁸ made a window in the nasal septum, operating through it from the opposite nostril. This opening he closed after the operation. Good²⁹ reported a method similar to Yankauer's. Clark³⁰ published an account of his intranasal operation in 1922. He passed a probe through a small external incision into the sac rather than through a canaliculus. The probe was then forced on through the lacrimal bone and acted as a visible guide in the nose.

Numerous other methods of treatment for lacrimal obstruction and infection have been in use. In ancient times the tear sac was opened and a red hot cautery forced through the lacrimal bone into the nose.

21 Burdon-Cooper, J. A Silkworm-Gut Lacrimal Style, *Ophth. Rev.* **26** 1, 1907.

22 Van Lint. Trepanation of the Os Unguis and Placing of a Rubber Drain in Chronic Dacryocystitis, *Am. J. Ophth.* **3** 367, 1920.

23 Spratt, C. N. Use of Callahan Tubes in Treatment of Chronic Dacryocystitis, *Am. J. Ophth.* **19** 601, 1936.

24 Yankauer, S. The Technic of Intranasal Operations upon the Lacrimal Apparatus, *Laryngoscope* **22** 1331, 1912.

25 Horgan, J. B. The Operation of Dacryocystorhinostomy. Its Indications and After-Treatment, *J. Laryng., Rhin. & Otol.* **31** 225, 1916.

26 Blegvad, N. R. Bemerkungen über die Westsche Operation, *Klin. Monatsbl. f. Augenh.* **65** 429, 1920.

27 Bookwalter, C. F. Intranasal Dacryocystostomy, *Arch. Ophth.* **49** 568, (Nov.) 1920.

28 Affolter. Die temporäre Resektion der Nasenscheidewand bei intranasalen Transsackoperationen, *Internat. Centralbl. f. Laryng.* **35** 27, 1919.

29 Good, R. H. Simplified Intranasal Operation for Obstruction of Nasolacrimal Duct, *Am. J. Ophth.* **4** 597, 1921.

30 Clark, J. S. Combined Intra- and Extranasal Operation for Dacryocystitis, *Illinois M. J.* **42** 104, 1922.

Escharotics also were employed. Woolhouse and Platner in 1724 opened the sac externally and drained it by making a hole in the lacrimal bone into the nasal cavity. Berlin in 1868 advocated total extirpation of the tear sac. This idea was revived in 1903 by Axenfeld.³¹ In 1904 Toti,³² of Florence, brought out his external dacryocystorhinostomy, which has enjoyed wide popularity. Toti incised the skin and elevated the periosteum off the lacrimal bone and the frontal process of the maxillary bone in the lacrimal fossa. This layer of periosteum, plus the tear sac, was displaced laterally. The bony wall of the lacrimal fossa was resected. Windows were then made in the nasal mucoperichondrium and in the lacrimal sac to correspond to the bony window and to cover its raw edge. The external incision was closed. Lagrange and Aubaret³³ opened the sac by external incision, applied the curet to its walls and then made an opening into the nasal cavity for drainage. Dupuy-Dutemps and Bourguet³⁴ operated in essentially the same way as Toti, except that they actually sutured the cut edges of the wall of the sac and the nasal mucosa. This procedure is far superior, in that healing is immediate and no after treatment is required. Mosher³⁵ in 1921 and 1923 reported his modification of Toti's operation. Recently Chandler,³⁶ of Boston, compared a series of operations done by Mosher's technic, another by Dupuy-Dutemps' and Bourguet's technic and another by his own modification of the external operation. Stokes³⁷ made an external incision, freed the lacrimal sac and severed it from its lower end. This he implanted in a bony window, which he made through an opening in the nose. Kutvirt³⁸ described a complicated approach to the tear sac from

31 Axenfeld, T. Die Exstirpation des Thränensackes zur Prophylaxe der septischen Infektion der Berufverletzungen des Auges, *Klin Monatsbl f Augenh* **41** (pt 1) 128, 1903.

32 Toti, A. Zum Prinzip, zur Technik und zur Geschichte der Dakrocystorhinostomie, *Ztschr f Augenh* **23** 232, 1910, *Technique systematique de la dacryocystorhinostomie*, *Ann d'ocul* **143** 417, 1910.

33 Lagrange and Aubaret. Contribution historique et clinique au traitement des dacryocystites par la creation d'une voie nouvelle a l'unguis, *Ann d'ocul* **138** 161, 1907.

34 Dupuy-Dutemps and Bourguet. Note préliminaire sur un procédé de dacryocystorhinostomie, *Ann d'ocul* **157** 445, 1920, *Procédé plastique de dacryocystorhinostomie et ses résultats*, *ibid* **158** 241, 1921.

35 Mosher, H. P. The Mosher-Toti Operation on the Lachrymal Sac, *Laryngoscope* **31** 284, 1921, The Combined Intranasal and External Operation on the Lacrimal Sac (Mosher-Toti), *Ann Otol, Rhin & Laryng* **32** 1, 1923.

36 Chandler, P. A. Dacryocystorhinostomy, *Tr Am Ophth Soc* **34** 240, 1936.

37 Stokes, W. H. Transplantation (Implantation) of the Lacrimal Sac in Chronic Dacryocystitis, *Tr Am Acad Ophth* **43** 343, 1938.

38 Kutvirt, O. Dacryorhinostomie par les voies orales, *Rev de laryng* **43** 675, 1922.

the mouth, his method recalls a "Denker operation," he resected the bony lateral nasal wall but did not open into the antrum. On the other hand, Von Eiken had previously reported draining the tear sac into the maxillary sinus.

Wiener and I³⁹ first reported our method in 1920 and I⁴⁰ again in 1923. Wood⁴¹ in 1933 reported as follows: "This operation has gradually been perfected until it has become remarkably successful in properly selected cases." He stated that in cases in which there is any form of obstruction between the eye and the sac this operation is not suitable.

Our procedure is as follows:

About two hours before beginning the operation the patient is given $\frac{1}{4}$ gram (16 mg) of morphine and $\frac{1}{150}$ grain (0.5 mg) of scopolamine hydrobromide. A second dose of scopolamine hydrobromide may be required, but a second dose of morphine is never given.

A cotton plug soaked in a 0.5 per cent solution of pontocaine hydrochloride is pushed under the upper and lower lids at the inner canthus and permitted to stay for about two minutes. With a fine platinum needle of a small hypodermic syringe the conjunctiva is punctured just below the lower punctum, and a few drops of a 2 per cent solution of procaine hydrochloride is injected, the needle is pushed forward along the border of the canaliculus, toward the sac, alternately to the conjunctival and the skin side, a small amount of the solution being injected each time. When the sac is reached, the needle is pushed toward the top of it, where a small amount is injected, and then toward the bottom of it, where a slightly larger amount is injected. This will catch all the terminal nerves supplying the canaliculus and the lacrimal sac, so that a probe can be passed without pain. The nose is cocaineized in the usual way.

The punctum is dilated with a punctum dilator, the Galewski dilator is then introduced, and the canaliculus is stretched. A Ziegler probe is passed into the punctum and along the canaliculus as far as the sac (fig 1). The tip being held well against the bone, the handle of the probe is raised until it is directed straight down, it is kept close to the bony wall until it reaches the bottom of the sac, when it is turned at an angle of 45 degrees and forced through the lateral nasal wall into the nasal cavity (fig 2). It should enter just in front of the anterior tip of the middle turbinate, which is identified by inspection of the nasal chamber through the nostril.

The probe is now slightly withdrawn in order to make a vertical incision through the mucoperiosteum, which passes through the point of entrance and extends $\frac{3}{8}$ inch (1 cm) above and below (fig 3). Its edges are elevated and reflected both forward and backward in order to expose the bare bony surface.

39 Wiener, M., and Sauer, W. E. New Operation for Relief of Dacryocystitis Through Nasal Route, *J. A. M. A.* **75** 868 (Sept 25) 1920.

40 Sauer, W. E. Dacryorhinocystotomy. Combined Methods, *Ann. Otol., Rhin. & Laryng.* **32** 25, 1923.

41 Wood, V. V. Intranasal Surgical Treatment of Chronic Dacryocystitis, *Tr. Am. Laryng., Rhin. & Otol. Soc.* **39** 554, 1933.

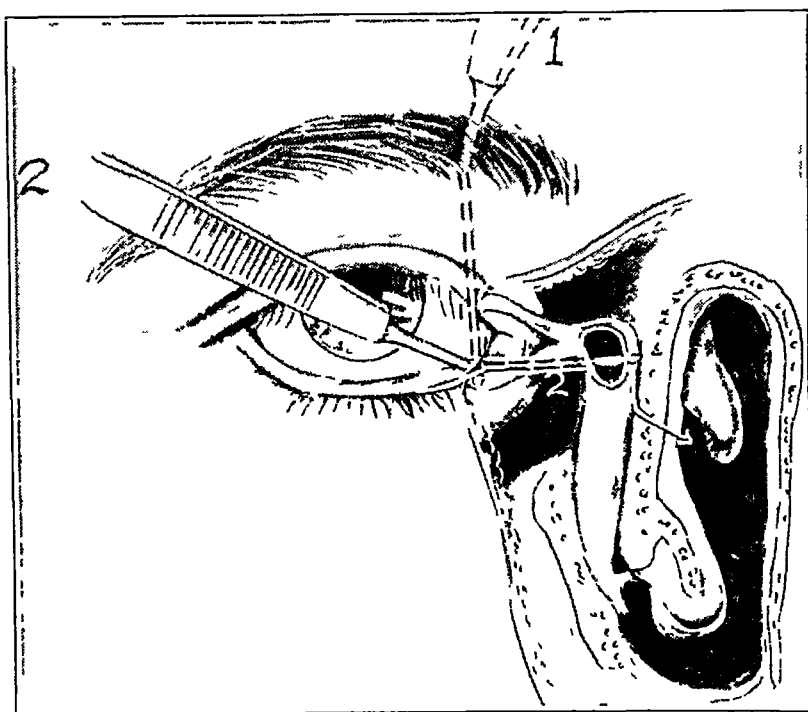


Fig 1—Ziegler probe passed into the punctum and along the canaliculus as far as the sac

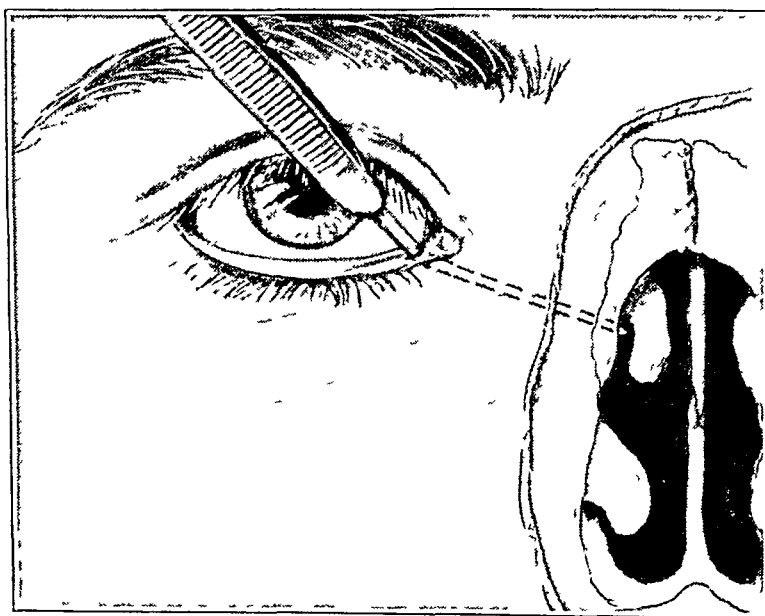


Fig 2—Probe forced through the lateral nasal wall into the nasal cavity

The probe is then pushed into the opening in order to determine exactly its location. An electrically driven burr 2 mm in diameter (fig 4) follows its disappearing tip and enlarges the opening in the bone until it attains a diameter of 8 to 10 mm, it is then extended far enough above to enable the probe to be introduced horizontally into the nose.

A portion of the sac is now pushed through the bony opening into the nasal cavity by means of a Bowman probe (fig 5), which is now substituted for the Ziegler. With the sac held in this position, biting forceps (fig 6) are introduced into the nose, and as much of the medial and lower wall of the sac as possible is removed with them.

The point of an Anel syringe is introduced into the canaliculus, and thorough irrigation is carried out through the sac and into the nose. The reflected muco-

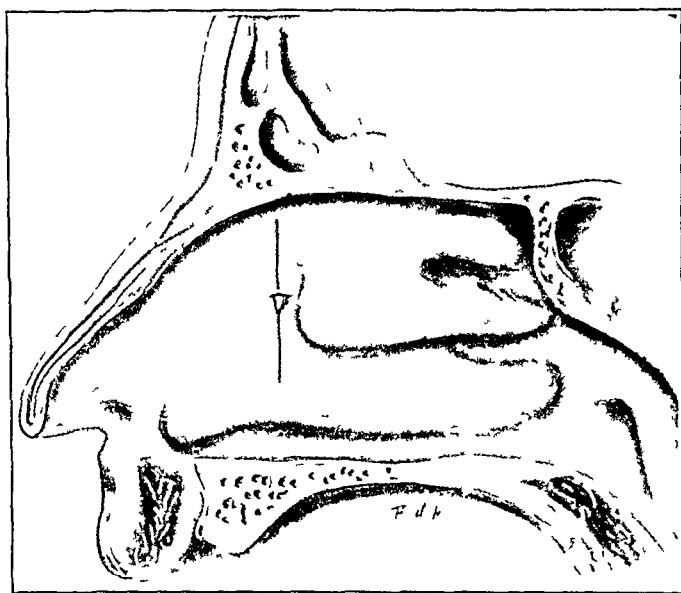


Fig 3—Vertical incision through the mucoperiosteum

periosteum is brought back into place (fig 7), partially covering the bony opening. This prevents excessive granulations and shortens the time of healing.

Bleeding is usually slight, in no case has packing been required. In some cases a punctum dilator must be used before the Ziegler probe can be introduced. In none of the cases did we find it necessary to slit the punctum. When the middle turbinate is large a portion of the anterior end may have to be removed immediately before the introduction of the probe. If the nose is narrowed by a septal deviation, submucous resection must precede the operation, though in the majority of cases this has not been found necessary.

On the third postoperative day a probe is introduced through the punctum, the canaliculus, the sac and the operative opening into the nose. This procedure may have to be carried out several times afterward. Granulations are kept down by means of a 40 per cent solution of silver nitrate until the wound in the nose is completely healed.

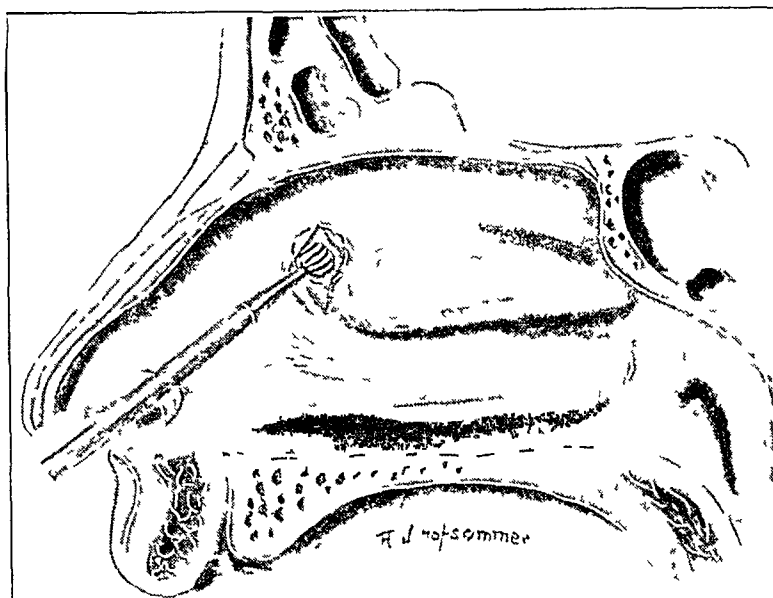


Fig 4—Electrically driven burr enlarging the opening in the bone

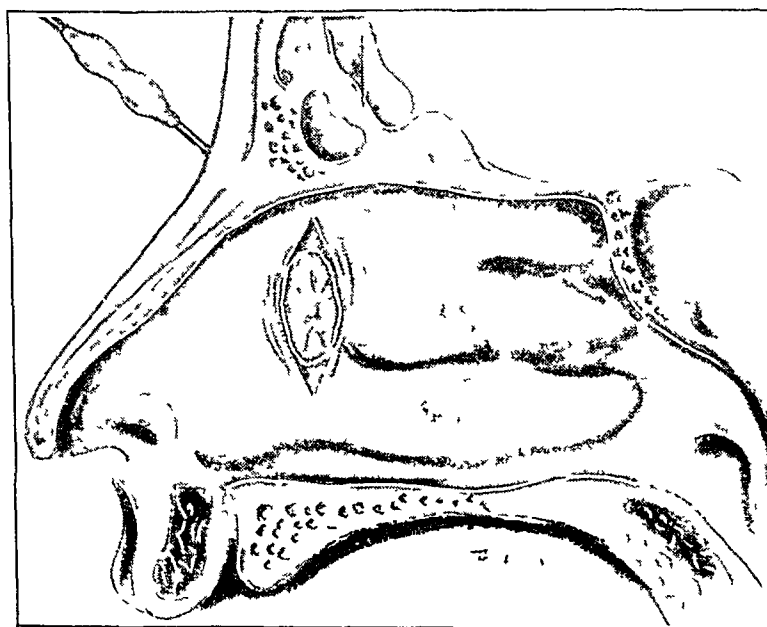


Fig 5—Portion of the sac pushed through the bony opening into the nasal cavity by means of a Bowman probe

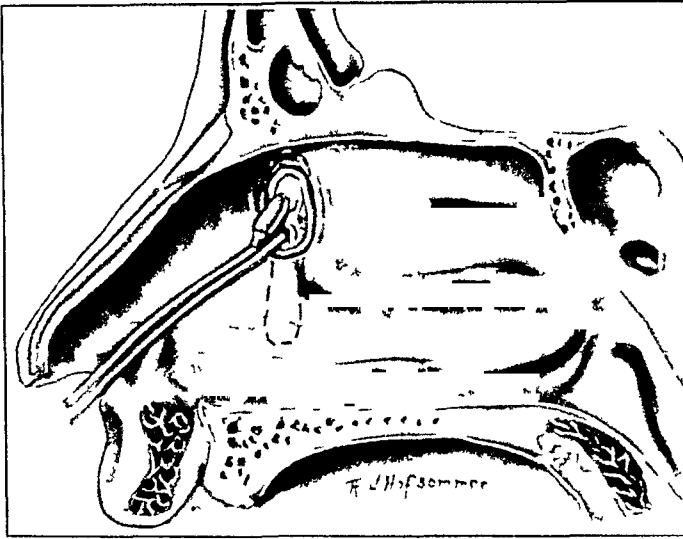


Fig 6—Biting forceps removing as much as possible of the medial and lower wall of the sac

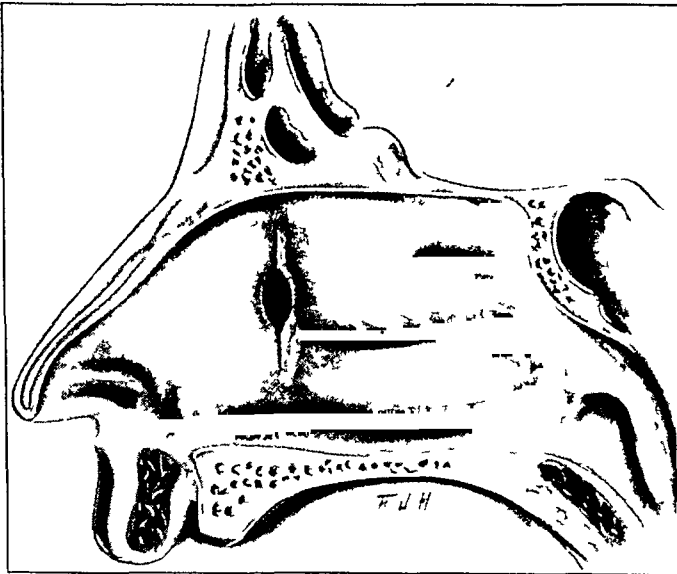


Fig 7—Reflected mucoperiosteum brought back into place

Wiener and I have been following this method since 1911. Some of our patients we have been able to follow for more than twenty years. Our results on the whole have been good. Complete cessation of the purulent discharge and freedom from tearing was secured in nearly every case. In a few, although the purulent discharge subsided, some tearing remained, especially when the patient was exposed to the wind. In a small percentage of cases the result was unsatisfactory, because a permanent opening in the nose could not be maintained. Some of our failures in the beginning were due to our operating, in our enthusiasm to try out the method, in all cases in which local treatment did not produce a response, without due consideration for the pathologic conditions in the lacrimal apparatus, the nose and the paranasal sinuses. We learned that a satisfactory result could not be obtained as long as one or more of the sinuses was chronically infected. It is therefore necessary to study all cases carefully and to eliminate pathologic conditions in the nose and the sinuses before attempting an operative procedure on the lacrimal sac. We now have roentgenograms of the sinuses made, regardless of clinical findings. The roentgen visualization of the nasolacrimal sac according to the method of Hourn⁴² has not been satisfactory in our hands. Unfortunately our results have been almost consistently bad in cases in which the bone has been fractured in this area, especially when callus was formed extensively. Failures occurred also when the lacrimal sac happened to be small. For young children with small nasal passages the after-care is a special problem. Nevertheless, we have had a number of cases of young children in which satisfactory results were obtained although the outlook was most discouraging.

The success of the operation depends largely on securing a sufficiently large bony opening into the nose so that the sac can be readily visualized when its nasal wall is pushed into the nose with the Bowman probe. It is also essential that its wall can be grasped with the Hartmann forceps and the greater part of it removed. In other words, one must be able to secure a large enough opening into the sac itself so that there will be no danger of its closing later on.

Our results have been better since we have preserved the mucoperiosteum by reflecting it before enlarging with the burr the opening made by the Ziegler probe. This mucoperiosteum is replaced so that the raw edges of the bony window are covered by the flaps after the operation has been completed. This shortens the time of healing by reducing the area of the granulating surface. Should granulations appear, they are reduced by the application of a 40 per cent solution of silver nitrate, as has always been our practice.

⁴² Hourn, G. E. X-Ray Visualization of Naso-Lacrimal Duct. *Ann. Otol., Rhin. & Laryng.* 46: 962, 1937.

In our opinion this method has all the advantages of other intranasal methods, avoidance of external scar and damage to the capillary action of the canaliculi, plus simplicity, which is lacking in most of them. If necessary the operation can be performed during active inflammation of the sac. In case of failure due to a membranous closure of the opening in the nose the sac can be easily reopened as a simple office procedure. We have done this a second or even a third time in a number of cases, finally securing permanent drainage. When this intranasal operation is not successful it does not interfere with any external operation, such as the Toti or the Mosher operation or with complete extirpation of the sac.

It is now the opinion of a number of ophthalmologists that the intranasal operation for drainage gives more security as a preliminary step preparatory to intraocular operations such as those for cataract or glaucoma when the sac is inflamed than does extirpation of the sac. Mattice⁴³ found pneumococci in the conjunctiva in 45 per cent of cases after extirpation. Bumke and West, following Elsching's method, found that cultures were usually negative within two or three days after the intranasal operation.

DISCUSSION

DR RALPH A. FENTON, Portland, Ore. Mr. Chairman, I should like to ask Dr. Sauer whether he and Dr. Wiener have found it possible to secure good results in this excellent operation, which I may say I have used myself for some twelve years on occasion, in cases in which the lacrimal sac has developed extensions down into the tissues of the face, has become bulging and has certain diverticula, as one might call them. It has been my feeling in following mistakes in technic that probably this class of dacryocystitis cannot be remedied by anything except an external operation, such as the Toti-Mosher, which my associates and I have used for a long time also, and that the excellent procedure of Dr. Sauer and Dr. Wiener must be reserved for cases in which the sac is relatively in its normal position, is not too extensively thickened and can be, as he has shown, pushed into the nose through an excellently made opening in its side wall.

It is true that if the Sauer procedure does not work, one can always do the external operation. But in attempting to operate by the external route after an attempt to do this much simpler procedure, my associates and I have found that the presence of scar tissue due to the earlier procedure made a little trouble in the dissection.

Since this method of operation was discovered, we have abandoned the type of work advocated twenty-five years ago by Dr. West, that, with its extensive instrumentation, is entirely unnecessary, and I feel that Dr. Sauer's procedure has been a great improvement.

DR HARRIS P. MOSHER, Boston. I agree heartily with Dr. Sauer that missionary work is still necessary among the ophthalmologists in regard to operations on the lacrimal sac for its chronic infections. Evidently, in Dr. Sauer's hands and Dr. Fenton's hands, this operation has been a success. After hearing

⁴³ Mattice, cited by West, J. M. The Clinical Results of the Intranasal Tear Sac Operation. *Tr. Sect. Ophth., A. M. A.*, 1931, p. 81.

West's paper and trying that procedure, I gave it up for the external operation. Unintentionally I modified and simplified the Toti operation, thinking I was doing the Toti, and have followed that procedure since. I, however, have always had the feeling that the fundamental principle of surgery was to operate by sight when and where one can. There are cases in which, evidently, Dr Sauer does operate fully by sight. But I am sure that there are other cases in which he does not and cannot fully operate by sight on account of the anatomic configuration of the nose.

I have had the fashion of saying, to encourage young operators, that the external operation on the lacrimal sac is one of the most satisfactory, from the economic standpoint and from the professional and scientific standpoint, of operations in surgery.

DR CHARLES T PORTER, Boston. My associates and I tried first the intranasal operation with some measure of success in a few cases, but they were not sufficient to warrant carrying on. Frequently, after failures by the ophthalmologist in trying to remove the entire sac or, later on, in trying to do the operation Dr Mosher developed at the hospital, the patients were turned over to us for the operative procedures to be completed. A split canaliculus and a split punctum leave the sac with a glued-up common punctum. Such patients gave us perhaps more trouble than all the rest, but we finally succeeded in treating them by eliminating the common punctum and leaving sometimes a stilet in the lower one for a while. This complicated condition has given us the most concern.

DR W E SAUER, St Louis. In answer to Dr Fenton, with reference to the pouching of the sac, that suggests one of the advantages of the Ziegler probe, which is a sharp-pointed instrument. One finds the bottom of the sac before one enters the nose.

In reference to Dr Mosher's remarks about the external operation, my associates and I never attempt an operation on a patient that has been operated on two or three times before by some of the ophthalmologists, but we have seen 1 or 2 patients, possibly more, in the clinic that have been operated on with large keloids, so that is the objection to the external operation. This operation is not a cure-all. One cannot expect success in cases in which there are pouches and in which the sac happens to be small. The important thing is to get rid of the pathologic condition in the nose before one attempts any operation on the lacrimal sac.

Case Reports

PAPILLARY TUMORS OF THE TONSIL

J JULIAN CHISOLM, M D, BALTIMORE

Large benign lymphoid tumors arising from the body of the faucial tonsil are rare. Small pedunculated papillomas or fibromas attached to the tonsils, the faucial pillars or the uvula are common. New¹ in 1931 reported 357 tumors of the tonsils and pharynx, of which 63 were benign. Of the latter, 35 were small pedunculated papillomas, which arose from the pillars in 40 per cent of cases, from the soft palate in 28.6 per cent, from the tonsils in 28.6 per cent and from the posterior wall of the pharynx in 2.8 per cent. There were only 5 true lymphoid tissue tumors, all occurring in women. One of these, a pedunculated growth 3 inches (7.6 cm) in diameter, attached to the upper pole of the left tonsil and composed of papillary tonsillar tissue, was strikingly similar to that in case 1 of this report. Harold D. Smith² stated that in a microscopic study of a series of 2,200 tonsils removed by operation he found 1 papilloma, which showed marked proliferation, spreading out from the capsule. In recent years benign tumors of the tonsils have been reported also by Friend,³ Kelemen,⁴ Pearlman and Pilot,⁵ Dunn,⁶ Reuys,⁷ Zoltan,⁸ Oppikofer and Weinhold⁹ and Frank.¹⁰ Zoltan described a diffuse papillomatous change in the tonsil which he characterized as tuberculous hypertrophy. He stated the belief that such growths may be

1 New, G. B. and Childrey, J. H. Tumors of the Tonsil and Pharynx (Three Hundred and Fifty-Seven Cases). I. Benign Tumors (Sixty-Three Cases), *Arch Otolaryng* **14** 596 (Nov.) 1931.

2 Smith, H. D. Microscopic Pathology of the Palatine Tonsil, *Arch Otolaryng* **21** 426 (April) 1935.

3 Friend, L. J. Fibro-Adenolipoma of the Tonsil, *Arch Otolaryng* **3** 448 (May) 1926.

4 Kelemen, G. Drei Tonsillentumoren, *Ztschr f Hals-, Nasen- u Ohrenh* **16** 556 (Nov. 8) 1926.

5 Pearlman, S. J., and Pilot, I. Lymphoid Tumors of the Tonsils. Report of Four Cases, *Arch Otolaryng* **5** 143 (Feb.) 1927.

6 Dunn, L. S. Tumors, Benign and Malignant, of the Tonsil and Peritonsillar Area, *Laryngoscope* **39** 16 (Jan.) 1929.

7 Reuys, H. Papillom des Gaumens—Schleimhautplattenepithelcarcinom der Tonsille—Cystadenoma papillare des Nasenvorhofes, *Ztschr f Hals-, Nasen- u Ohrenh* **30** 167 (Dec. 18) 1932.

8 Zoltan, S. Ueber die tuberosc Hypertrophie der Gammmandeln, *Monatsschr f Ohrenh* **69** 864 (July) 1935.

9 Oppikofer, E., and Weinhold, H. Ueber die papillare Hyperplasie des lymphatischen Rachenringes, *Arch f Ohren-, Nasen- u Kehlkopfh* **144** 135, 1937, "Ueber papillare Hyperplasie des lymphatischen Rachenringes" Bemerkungen zu den Ausfuhrungen von Dr. Stefan Zoltan, *ibid* **144** 347, 1938.

10 Frank, I. Papilloma of the Tonsil, with Report of Three Cases, *Ann Otol, Rhin & Laryng* **47** 715 (Sept.) 1938.

induced by stasis, infection or intoxication but expressed feeling that the primary change is hypertrophy followed by stasis, hyperemia and edema. Oppikofer expressed the opinion that papillomatous tumors have an infectious basis.

Frank reported 3 cases and furnished a bibliography of twenty-two articles. He stated that Vidau in 1937 found reports of only 16 cases of tonsillar papillomas in the literature. Frank described the microscopic picture of these benign growths. They are composed of squamous epithelium extending in finger-like, sometimes branching projections about a delicate core of connective tissue without inflammatory changes. Reuys, reporting a papilloma of the soft palate the size of a half dollar in a girl of 4 years, observed that the tumor was characterized histo-



Fig 1 (case 2) —Low power magnification of a papillary tumor almost completely replacing normal tissue in the upper half of the right tonsil

logically by extensive and rapid formation of immature connective tissue elements and that mature connective tissue was almost lacking. In addition to papillomas, nonmalignant growths which may be encountered in the tonsils or peritonsillar area include adenomas, fibromas, chondromas, angiomas, dermoid cysts, osteomas, myomas, fibrochondromas, fibrolipomas and fibrolymphadenomas.

REPORT OF CASES

CASE 1 —A woman aged 64 was seen on July 25, 1933, complaining of difficulty in breathing at night, first noticed five years previously. At the onset she had consulted her family physician who told her that the right tonsil was much enlarged. Since then it had gradually increased and the difficulty in breathing

had progressed to such an extent that she could not sleep except when lying on the right side. The only other symptoms were fullness in the throat, a pulsating sound in the right ear at night and some pain and stiffness in the joints. On examination the only significant findings were in the throat. The left tonsil was of moderate size and showed evidence of chronic infection. There was a large,

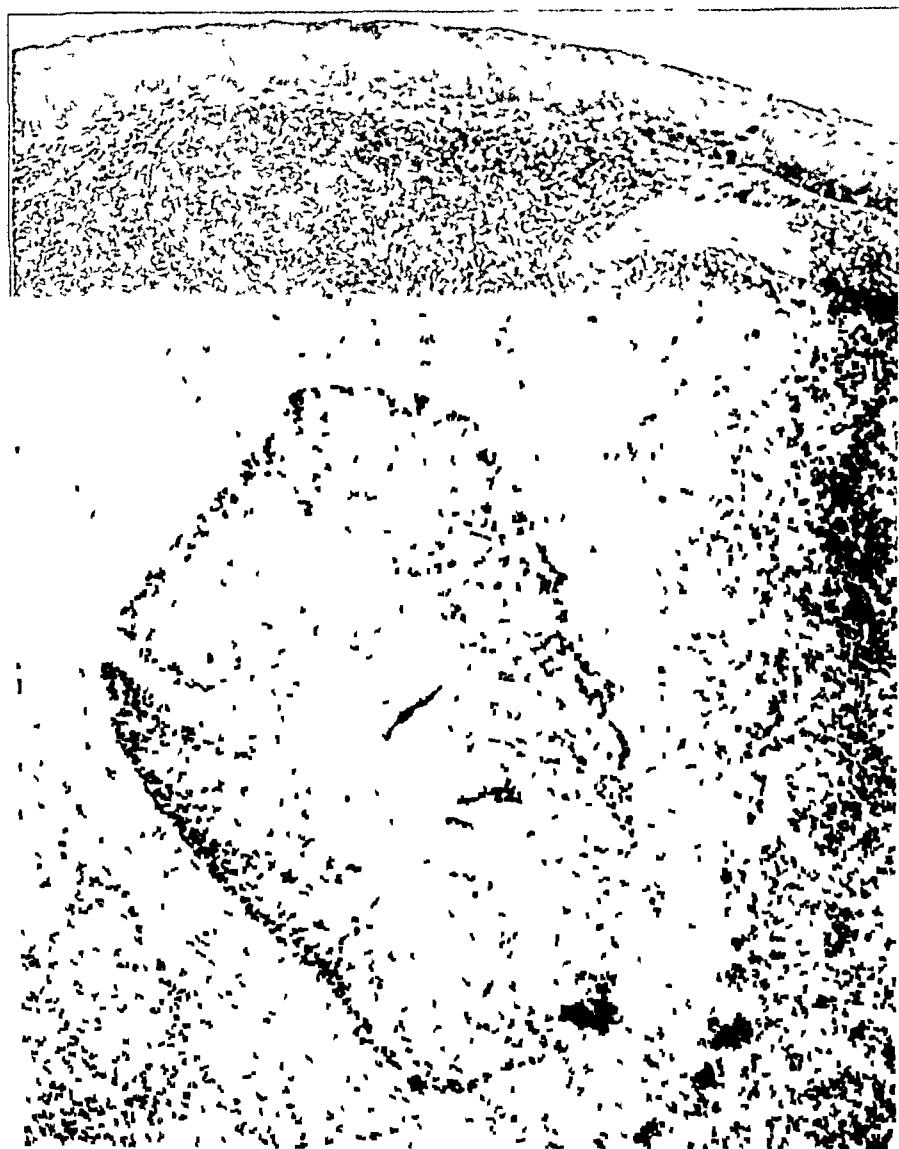


Fig 2 (case 2) —Higher magnification of the area marked in figure 1, showing in cross section, a column of tumor tissue beneath the pharyngeal surface of the tonsil

rather pedunculated growth arising from the center of the right tonsil and extending beyond the midline. Its surface was nodular and not ulcerated but beneath the epithelium were a number of small cysts containing yellowish material. There were no enlarged glands in the neck. A diagnosis of benign tumor of the right tonsil was made. On August 5 an operation was performed at the Church Home



Fig 3 (case 2) —High power magnification showing finger-like proliferations of lymphoid tissue covered with stratified squamous epithelium

and Infirmary with the patient under anesthesia induced by avertin with amylene hydrate and nitrogen monoxide with oxygen. Dr. Grant Ward removed the right tonsil and the tumor in one mass by throwing a tonsil snare around it and applying a strong cutting current to the wire. Remaining tags of tissue in the fossa were coagulated. I then removed the left tonsil by sharp and blunt dissection. There were no postoperative complications and when the patient reported for observation, on December 5, she was free of symptoms and the throat looked clean. A pathologic report by Dr. Vernon L. Norwood was as follows: "This specimen is a mass of tissue 2.5 by 1.5 by 1 cm., which is said to have been removed as a pedunculated growth from the tonsil. The surface presents a smoothly lobulated cryptic appearance similar to that of a normal tonsil. On section numerous cysts filled with yellowish purulent material were found." The diagnosis was papillary hypertrophy of the right tonsil.

CASE 2—A girl aged 4 years was referred by her pediatrician because of nasal obstruction and enlargement of the right tonsil which had been noted for six months. Examination, on April 12, 1938, revealed moderate enlargement of the glands at the angles of the jaws on both sides. The left tonsil was moderately enlarged. The right tonsil was tremendously enlarged and extended well beyond the midline. The surface was lobulated and cryptic and felt soft to palpation. The physical examination otherwise did not reveal any abnormalities. The tonsils and adenoids were removed with the patient under ether anesthesia at the Johns Hopkins Hospital on April 14. The adenoids were small. The left tonsil dissected out easily. The right tonsil proved to be friable, and the tremendous enlargement was confined to the upper pole. It extended deeply beneath the anterior pillar and seemed to be invading the muscle of the tonsillar bed. A definite capsule could not be demonstrated. Bleeding was rather profuse. The operator suspected a sarcoma and removed a portion of the mass for a frozen section. A benign growth was reported. The mass was completely removed then, by sharp and blunt dissection. The only postoperative complication was mild scarlet fever, which developed on the sixth day after operation. The child was examined seven months later. She was free of symptoms, and the throat was clear. The pathologic report was as follows: "The left tonsil is 1.5 cm. in diameter. The right tonsil is 3 cm. in diameter, with unusually large and distinct lobulation. The lymphoid follicles are large, with huge, extremely active germinal centers. A suggestive malignant change is not observed. The innermost layers of epithelium are slightly infiltrated by inflammatory cells. The tonsillar crypts are evidently extremely deep, and several of them are found in cross section in the middle of the section showing small islands of lymphoid tissue surrounded by stratified squamous epithelium, giving the picture almost of a papillomatous tumor" (figs. 1 to 3).

These cases of benign papillary tumor of the tonsil are reported because of the rarity of the condition. Histologically the two growths were similar. One occurred in a woman of 64 and the other in a girl of 4 years. It is conceivable that had a biopsy been made of certain portions of the tumor illustrated, a mistaken diagnosis of malignant tumor might have been made. This point should be kept in mind when clinical observations and the biopsy report are at variance in a case of pharyngeal tumor.

MENINGOCOCCIC CORYZA

L DELL HENRY, M D, AND HUGH A KUHN, M D, HAMMOND, IND

Meningococcic coryza, or rhinitis, is a condition rarely seen. We are unable to find any reports in the literature. That meningococci are carried in the nasopharynx by a fair percentage of normal persons has been established by numerous American and English workers in surveys made both in the army and in civilian life. Bacteriologists and clinicians all report that the cultures must be taken high in the pharynx behind the soft palate. So to find a large number of meningococci in a nasal secretion is unexpected and unusual.

REPORT OF A CASE

A baby girl, 2½ years old, was brought into the office by her mother, who gave a history of bleeding from the nose on several occasions in the past two weeks, accompanied by a profuse discharge and severe sneezing spells. Examination showed the temperature slightly elevated, and the nose was found to be full of mucoid material. There was markedly pale edema of the mucous membrane but only slight inflammation. The vessels of the septum on both sides were dilated. The clinical appearance was that of an allergic nose, plus dilated vessels in Kiesselbach's triangle. Smears were made of the nasal discharge and stained with Wright's stain in preparation for examination for eosinophils. On examination of the smears, however, no eosinophils were found, but some polymorphonuclear leukocytes and many diplococci were seen. Examination of other smears, stained by Gram's method, showed an abundance of gram-negative diplococci, morphologically like the meningococcus. Both intracellular and extracellular organisms were found. Further bacteriologic studies revealed practically a pure culture of these gram-negative diplococci, which were agglutinated by meningococcus antiserum in a dilution of 1:320.

On questioning it was learned that there were 2 other children in the family, both of whom had had "colds," but a history of nosebleed was not given for these two children. On request, the other 2 children were brought into the office for examination. They were 15 months and 4 years old, respectively.

Examination of these 2 children gave essentially the same results: slight elevations in temperature, profuse nasal mucopurulent discharge, slight inflammation of the mucous membrane of the nose and enlargement of the tonsils but not injection of the pharynx. There was less edema of the nasal mucous membrane in these 2 children than in the first child. Smears and cultures revealed meningococcus the same as in the original case.

For all 3 children sulfanilamide was prescribed, and they were kept under close observation and in isolation. At no time did any symptoms simulating meningitis appear. Six days after treatment had been instituted, the children were all clinically well. Repeated cultures were taken after this time from the nose and nasopharynx, and meningococci were not found.

Cultures taken from the mother on two occasions did not yield meningococci.

COMMENT

It seems that children having such an apparently severe infection, if one may judge this by the numbers of organisms seen in the smears made from the discharge and the amount of discharge present, should be clinically more ill than these children were. They were up and around with no loss of appetite or of energy. Clinically these children appeared like allergic patients except for the bleeding from the nose and that was easily explained on the basis of the large and exposed vessels in Kisselbach's triangle or could have been due to possible diphtheritic infection. If the condition were allergic the management, naturally, would be vastly different from what it would be if it were nasal diphtheria, meningococcic infection or infection with one of the many other infectious or contagious bacterial agents.

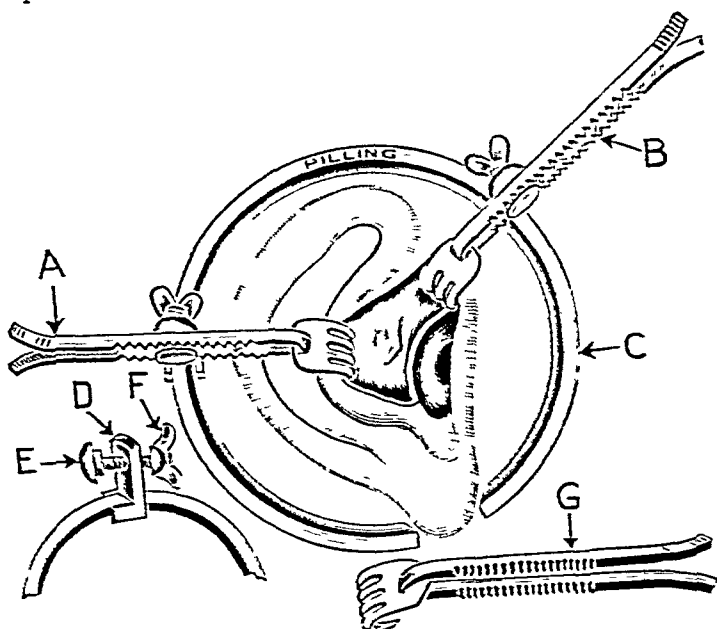
We report this case not only because of its unusualness but to bring out the importance of making smears and cultures from nasal secretions in children for the purpose of differential diagnosis.

Clinical Notes; New Instruments and Technic

MASTOID RETRACTOR, SELF RETAINING, FOR THE ENDAURAL, ANTAURICULAR TECHNIC

BENJAMIN H SEUSTER, M D PHILADELPHIA

A number of otologists have adopted the endaural method of approach to the mastoid described by Dr Julius Lempert of New York. A number of them employ this method of approach occasionally. Some of them are doing fistulization for deafness as described by Dr Lempert in which case the endaural approach is practically indispensable.



Mastoid retractor, self retaining for the endaural antauricular technic. G, represents the retractor, A, the retractor open at one end with provision for pulling. B, the ratchet to fix the retractor. C, the piston ring around which the retractors are moved to the proper position, D, the carrier for the retractor. E, the head of the set screw with a projection to fit into the ratchet and F, the fly nut to tighten the retractors.

One of the inconveniences of this method is the lack of a self-retaining retractor on the market which would serve satisfactorily. An assistant, therefore, is employed solely for the purpose of holding hand retractors throughout the operation.

The operation for deafness requires many hours, and it is an ordeal for an assistant to sit through it holding the retractors. In this approach it is necessary to shift retractors from one point to another. Therefore none of the retractors on the market which are fixed at one point serve the purpose. These retractors also

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From the Department of Otolaryngology Graduate School of Medicine University of Pennsylvania Service of Dr George M Coates

fail to spread the incision in the proper directions. Since I had observed and performed mastoidectomies through this approach, it occurred to me that traction is constantly within the radius of a circle and also that any shift of the retractors places them in another radius of the same circle. A retractor has, therefore, been devised to answer the problem of shifting the retractors within various radiuses of a circle.

A piston ring and retractors with prongs similar to those used by Dr. Lempert but lengthened to suit the purpose were obtained. The stems of the prongs were built like the prongs of a tuning fork which could slide through a set screw and hold in place at various points. Grooves were made on the side of the prongs to keep them from slipping backward and forward. The brackets on which the prongs were placed were tunneled to fit the piston ring. When it is necessary to shift the radius within the circle, a set screw is loosened, the retractor is moved forward, and the brackets may be pushed around the circle to another radius. In this way traction can be made in any radius of the circle without the necessity of an assistant constantly holding and making traction on them, which, as has been stated, may have to be done for hours. An illustration accompanies this description.

The retractors are made by The George P. Pilling and Son Company, Philadelphia.

1824 Pine Street

CATHETERIZING THE SPHENOID

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One is frequently called on to determine the presence or absence of infection in the sphenoid sinus. Because of its location, roentgen reports are often misleading. It therefore becomes imperative to attempt catheterization, either for irrigation or for the instillation of an opaque oil. For this reason a survey of 300 non-macerated skulls was made to determine the percentage in which the sphenoid sinus could be catheterized, the reason for failure and some data that would make failure less common. It is self-evident that if one could locate the ostium and have some way of knowing one has entered the sphenoid cavity irrigation would be easy.

In a recent study of 1,600 macerated skulls,¹ it was found that the bony ostium is either round or oval, the diameter of the round bony ostium being 5.03 mm., while the oval ostium measures 4.02 mm. by 5.8 mm. The membranous ostium conforms in shape to the bony ostium but is much smaller, often almost completely closing the bony opening. There are approximately twice as many round ostiums as oval. The membranous ostium varies from the size of a pin point to 8 mm. in diameter, the average diameter of the membranous round ostium being 3 mm. and the measurements of the oval 2.4 mm. by 4 mm. In most of the cases the mucosa would be traumatized on catheterization, the membranous web occasionally being punctured.

In the macerated skulls, the average distance from the anterior nasal spine to the ostium of the sphenoid sinus in the male was 60.7 mm., and in the female, 57.2 mm. In the living and in the nonmacerated skulls 10 mm. should be added to this measurement for the soft parts encountered at the anterior nares.

¹ Dixon, F. W. A Comparative Study of the Sphenoid Sinus, *Ann. Otol., Rhin. & Laryng.* 46: 687 (Sept.) 1937.

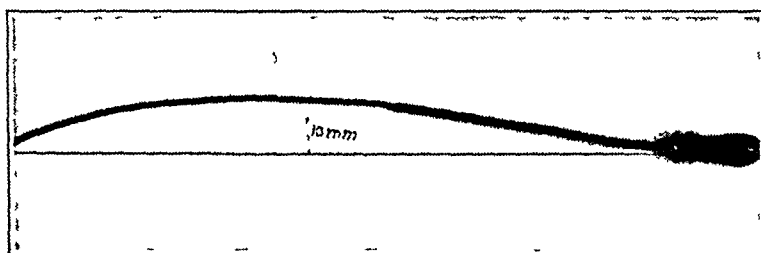


Fig 1—A flexible sphenoid catheter bent to conform to the curve of the lateral nasal wall. The shoulder is 7 cm from the tip.

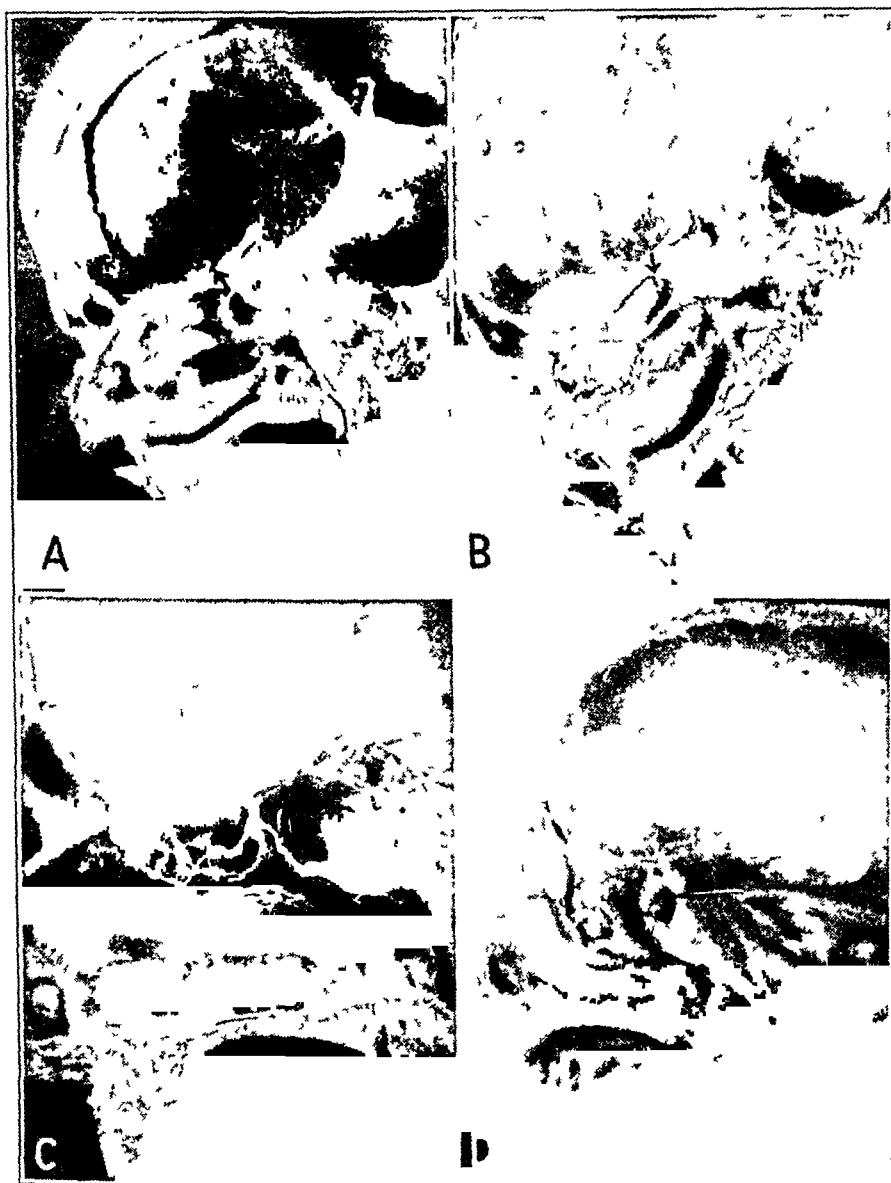


Fig 2—A, the ostium of the sphenoid sinus pointing *upward*. A catheter introduced in the usual manner would probably slide over the ostium. If force were used, the brain cavity might be punctured. B, the ostium pointing *inward*. A small right sphenoid sinus, capacity 0.5 cc, empties by a circular route through the posterior tip of the superior turbinate. C, ostium pointing *downward*. The sphenoid cavity is enormous, with thin walls. A probe is in place, pointing downward. D, ostium pointing *outward*. Owing to an unusual arrangement of the ethmoid cells, the sphenoid sinus has developed by itself.

The opening of the sphenoid sinus is usually in the upper mesial fourth of the anterior wall of the sinus. The distance from the septum to the center of the ostium varies from 1 to 15 mm, the average distance being 4.92 mm. The distance from the cribriform plate to the center of the membranous ostium also varies from 1 to 15 mm, the average being 8.25 mm.

The most common exception to the location given is when a large postethmoid or ethmosphenoid cell occupies the superior portion of the bone and pushes down

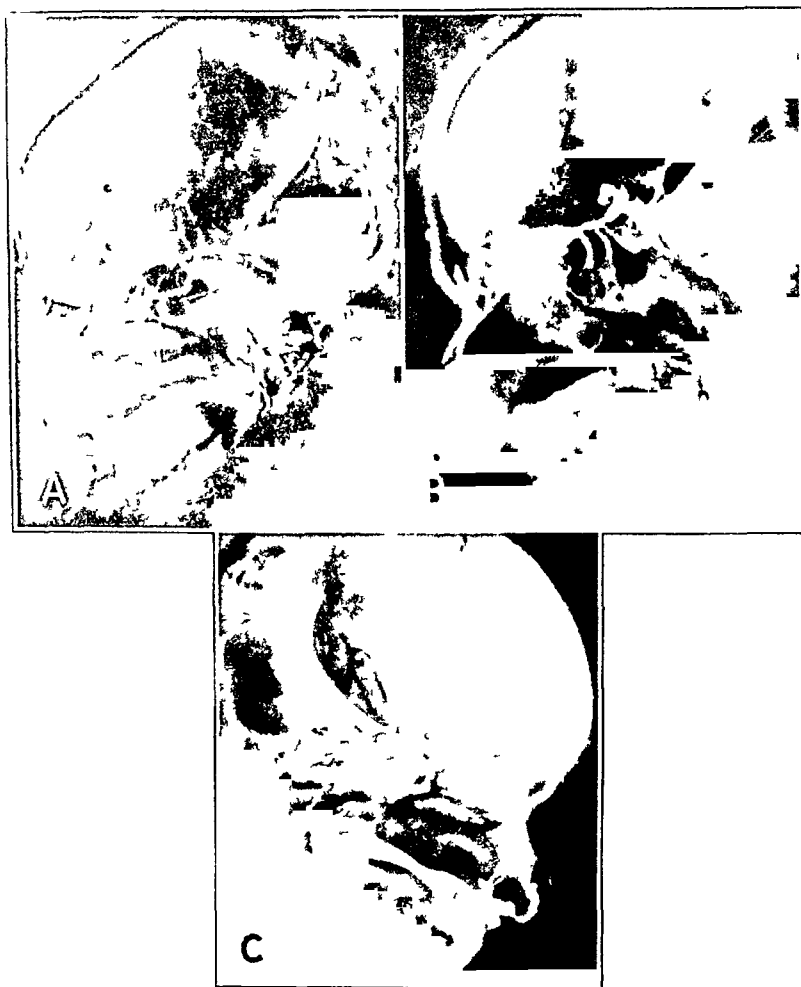


Fig 3—4, a superior and inferior sphenoid cell, each with its own separate ostium. B, an unusual arrangement of posterior ethmoid and sphenoid cells, each having a separate ostium. The sphenoid sinus is impossible to catheterize. C, a small *left* sphenoid sinus almost completely surrounded by the *right* sphenoid sinus. The capacity of the left sphenoid sinus is 0.5 cc. The capacity of the right sphenoid sinus is 7 cc. It was possible to catheterize both sphenoid sinuses. The left is so small that one is unable to tell whether or not the catheter is in the cavity.

the sphenoid cell with its ostium. Here the ostium is usually found close to the ethmoseptal angle, approximately 2.4 mm from the angle.

In an attempt to irrigate the 600 sphenoid sinuses in this group, the sphenoid cavity was entered either by catheterization or puncture in 75 per cent of the cases,

with 25 per cent failures. In 7 per cent of the attempts listed as successful the sphenoid sinuses were so shallow or the ostium so close to the roof that it was uncertain whether the sinus had been entered. Therefore, in only 70 per cent of the cases could one be positive that the efforts were successful. These skulls were all fresh specimens, and, I believe, the percentage of success corresponds closely to that met in actual practice. Dr Oscar Batson, in a personal communication, expressed the opinion that this percentage of success is too high. If time and care are taken in anesthetizing and shrinking the nasal mucosa, it will be possible to irrigate the sphenoid cavity in the majority of cases. It should always be attempted in patients under suspicion. A roentgenogram should be taken when puncture of the anterior wall of the sphenoid sinus is contemplated. This wall may be dense bone, several millimeters thick, or may be of egg shell consistency, separating the ethmosphenoid recess from the dura.

A long thin flexible catheter with a shoulder 7 cm from the tip is preferred. This is bent so that the greatest curve is approximately 10 mm high. In many instances this curve will be too great, but it should conform to the curve of the middle turbinate, bisecting its anterior tip. I believe that this gently curved cannula is better than those bent at an angle similar to the bend of a eustachian catheter, because, first, the turbinates are so shaped, second, it allows one greater leeway in one's search for the ostium and, finally, if one enters the sphenoid sinus one can by slightly rotating the catheter further enter the cavity and thus more thoroughly irrigate.

Various writers in the past have stressed the size of the ethmosphenoid recess as determining the success or failure of catheterization. I believe that a large recess is helpful, but, I feel, success depends more on the angle at which the ethmoid joins the septum. This one can tell by means of the probe. The average ethmoseptal angle is 60 degrees. If the angle is acute, one's chances of success are diminished. A deflected septum interferes with catheterization on the side of the deflection but increases the angle on the opposite side and thereby facilitates catheterization. The failures were mainly in cases of an ethmoseptal angle of less than 30 degrees. If the anterior wall of the sphenoid sinus is perpendicular or faces down, the ostium probably faces forward. If the anterior wall slopes backward toward the cribriform plate, the ostium faces upward.

Figures 2 and 3 illustrate abnormally placed ostia.

The reasons for failure in most cases were as follows:

1. A deflected septum interfered with the passage of the catheter.
2. The ethmoseptal angle was too sharp.
3. The ostium was abnormally placed.

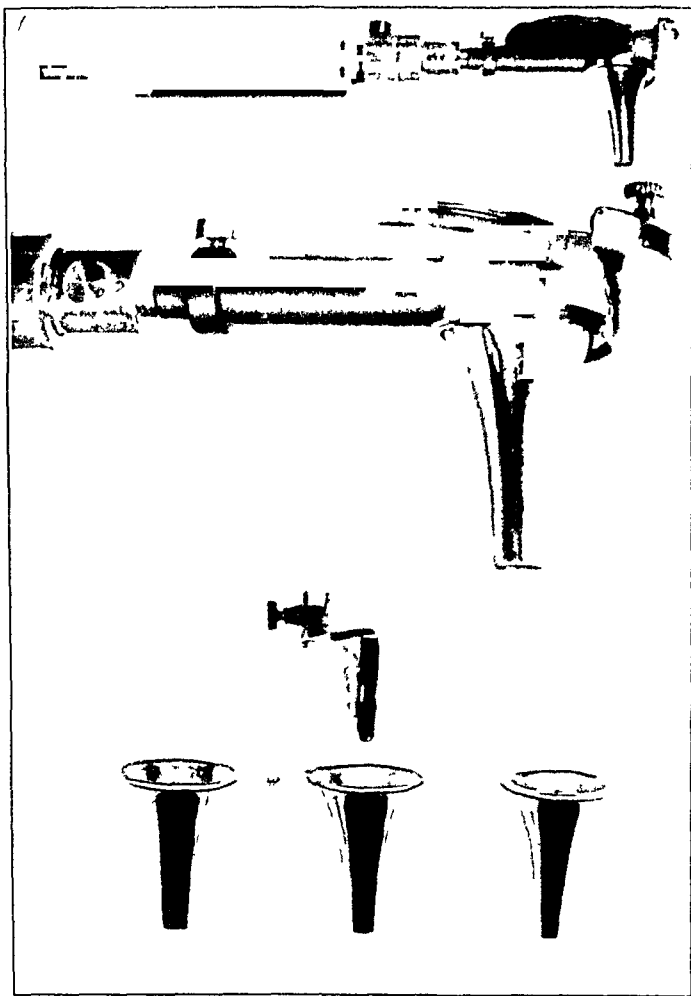
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OTOSCOPIC ATTACHMENT

W. M. FITZHUGH, JR., M.D., AND C. E. HASS, M.D., SAN FRANCISCO
Assistants in Surgery, Leland Stanford Junior University Medical School

The purpose of this paper is to introduce to the medical profession a new instrument which makes an ophthalmoscope into an otoscope. At present the

ordinary diagnostic electric equipment is expensive,¹ and we feel, therefore, that it is essential that the ophthalmoscope should be adapted to as many uses as possible. Heretofore a special otoscopic head has had to be purchased, which has made the carrying case bulky. Our attachment is a compact clip which fits over the top edge of the ophthalmoscope, whose lenses are utilized in the regular way to obtain the necessary magnification and focus of the different parts of the external auditory canal. This device will not interfere with examination of the fundi, it being necessary to remove only the Townes ear speculum from the clip.



Photograph of the attachment

The one disadvantage is that there is no aperture to perform myringotomies, but this deficiency is made up by the following facts: (1) The magnification of any part of the external auditory canal is far greater than that attained with the usual electric otoscope, and (2) the attachment is more compact and less expensive.

Carl Reiner, of Vienna, improved this instrument, making the clip separable

¹ The present prices of the various otoscopic heads range between \$12 and \$15. Our attachment can be retailed for \$2 to \$3.

Progress in Otolaryngology

Summaries of the Bibliographic Material Available in the
Field of Otolaryngology

CHRONIC PROGRESSIVE DEAFNESS, INCLUDING OTOSCLEROSIS AND DISEASES OF THE INNER EAR

GEORGE E SHAMBAUGH JR., M D
CHICAGO

The most important contribution on otosclerosis for 1938 is the report of the restoration of serviceable hearing in a large proportion of patients operated on by a new surgical procedure. An unusual number of excellent contributions on Menière's disease appeared in the world literature for 1938.

An attempt is made in this summary to include only articles which bring something new to the knowledge of progressive deafness. My editorial comments are in brackets. The material is arranged, as in last year's summary, in the following order:

Otosclerosis

Pathology and Etiology

Treatment

Labyrinthine Deafness

Pathology of Nerve Deafness

Hereditary Nerve Deafness

Traumatic Nerve Deafness

Nerve Deafness from Drugs

Nerve Deafness from Infections

Nerve Deafness from Allergy

Nerve Deafness from Miscellaneous Causes

Treatment of Nerve Deafness

Menière's Syndrome

OTOSCLEROSIS

Pathology and Etiology—Nager and Fraser¹ describe the unusual finding of formation of new bone in the scala tympani in 6 otosclerotic patients. They call attention to the fact that as a rule the inner ear

¹ Nager, F. R., and Fraser, J. S. On Bone Formation in the Scala Tympani of Otosclerosis, *J. Laryng & Otol* **53** 173-183 (March) 1938. Nager, F. R. Ueber Labyrinthveränderungen bei Otosklerose, *Schweiz. med. Wchnschr.* **1** 85-86, 1938.

shows little or no change in otosclerosis, the pathologic condition being confined to the labyrinthine capsule. In each of the 6 cases in which new bone was found in the scala tympani the otosclerotic process was extensive, involving both windows and often with foci in other parts of the labyrinthine capsule, such as the regions around the semicircular canals, in the internal meatus and around the cochlear aqueduct. In each case the otosclerotic focus had extended to the endosteum of the scala tympani and the newly formed bone was attached to the otosclerotic focus. This new bone was lamellar, and in 4 of the 6 cases the otosclerotic bone had begun to invade the newly formed lamellar bone. The authors conclude that the formation of new bone in the scala tympani is the result of irritation of the endosteum by the otosclerotic process.

Bast² continues his fundamental studies of the development of the otic capsule with a description of the fossula post fenestram. This structure, less familiar to most otologists than the fissula ante fenestram, consists of a small evagination of connective tissue from the vestibule into the bony capsule of the labyrinth just posterior to the oval window. It is comparable to the fissula ante fenestram in character and content. It differs from the fissula in that its shape is more sacklike and, as a rule, it does not extend through to the middle ear, although in a few cases it does communicate with both the vestibule and the middle ear. The fossula is also less constant than the fissula, being found in only two thirds of the ears in the fetus and early childhood. Tracing the development of the fossula from its earliest evidence in the 8 week embryo into early childhood, the author concludes that it is a more rudimentary and less constant structure than the fissula but that, like the fissula, it represents an area of instability where, during the process of obliteration, calcification and formation of cartilage and new bone occur, the new bone resembling otosclerotic bone. The author concludes that the fissula frequently and the fossula less frequently are the site of the formation of new bone that may represent the first stage in the formation of otosclerotic bone. This accounts for the occurrence of otosclerotic bone usually anterior to the stapes.

[Comment: Bast has given the best explanation for the origin of otosclerotic foci yet offered. He has not explained why the focus that begins in the region of the fissula ante fenestram or, less often, around the fossula post fenestram should in some cases grow and invade the surrounding labyrinthine capsule, leading eventually in a small proportion of cases to ankylosis of the stapes and deafness.]

2 Bast, T. H. Development of the Otic Capsule. The Fossula Post Fenestram, *Arch Otolaryng* 27: 402-412 (April) 1938.

Anson, Karabin and Martin³ trace the development of the stapes and the region of the oval window from their earliest appearance to their adult form. The stapes is first discernible as a fairly distinct ring of cartilage in the human embryo of 7½ weeks. At 10 weeks it is becoming stiltup shaped, and at 19½ weeks it has approximated adult size and ossification begins. The oval window also reaches its adult size and shape at this early age, and the fissula ante fenestram and the fossula post fenestram, when present, are surrounded by cartilage, which at this age is directly continuous with the margins of the oval window. Subsequently the intervening space becomes ossified, but both the fissula and the oval window retain their embryonic cartilaginous rim throughout life.

Nager⁴ briefly reviews the pathology of bone of the labyrinthine capsule. Of interest is the statement that in fractures the periosteal layer of the capsule heals normally, while the endochondrial layer never heals by bony union, since it cannot form new bone. The histologic picture of otitis fibrosa of Recklinghausen and of Paget's disease in the temporal bone is closely related to otosclerosis.

Meller⁵ describes the temporal bone of a patient with renal rickets. In this disease of children chronic nephritis is combined with osseous changes of rickets. The mastoid process, petrous apex and periosteal capsule showed changes resembling rickets, consisting of the formation of wide osteoid spaces, whereas the endochondral and endosteal layers of the capsule remained almost free from changes.

[Comment. The relative resistance to systemic influences of the part of the capsule most involved in otosclerosis speaks against a general metabolic cause for otosclerosis and in favor of a purely local cause, such as has been indicated by Bast.]

Wilson⁶ presents an interesting discussion of the various theories of the cause of otosclerosis. There are about six important theories, the best known being that of Wittmaack, who stated the belief that otosclerosis is due to venous stasis in the labyrinthine capsule resulting in osteoporosis. He based his theory on experimentally produced stasis in chickens. However, not all histologists agree that the changes observed in chickens are identical with otosclerosis, secondly, Wittmaack was not

3 Anson, B. J., Karabin, J. E., and Martin, J. Stapes, Fissula Ante Fenestram and Associated Structures in Man. From the Embryo of Seven Weeks to That of Twenty-One Weeks, *Arch Otolaryng* **28** 676-697 (Nov.) 1938.

4 Nager, F. R. Ueber die Knochenpathologie der Labyrinthkapsel, *Acta oto-laryng* **26** 127-137, 1938.

5 Meller, H. Die Veränderungen des Schläfenbeins bei Rachitis und "renaler Rachitis," *Monatschr f. Ohrenh* **72** 639-671 (July) 1938.

6 Wilson, J. G. Present Status of the Problem of Otosclerosis, *Arch Otolaryng* **28** 946-953 (Dec.) 1938.

able to produce these changes in monkeys, and, finally, he failed to explain the venous stasis that according to his assumption is present in otosclerotic patients

The second theory is that of O. Mayer, who described otosclerosis as a reaction to mechanical strain. He stated the belief that the fissula ante fenestram is a synchondrosis or joint to compensate for tensions between the cochlea and the semicircular canals and that the otosclerotic focus begins as porous bone to meet the mechanical strain. Against this theory Bast pointed out that the structure of the fissula is not comparable to synchondrosis. Also it does not explain why the fissula ante fenestram is found only in man.

Gray suggested that otosclerosis is the result of insufficient blood supply to all the nerves in the organ of hearing, basing his theory on the observation that the degree of deafness bears little relation to the extent of the osseous disease and that the severity of the tinnitus is not related to the duration.

Fraser stressed the influence of catarrhal and suppurative otitis media as a factor inciting to otosclerosis in persons with a hereditary tendency. This fails to explain the occurrence in many cases of otosclerosis with no evidence of inflammation of the middle ear, past or present.

Nager and M. Meyer, impressed by the histologic similarity between otosclerosis and Paget's disease, described otosclerosis as localized osteodystrophia.

The author (Wilson) points out that the otic capsule differs from normal bone elsewhere in the body in that it is essentially immature bone. The capsule, like all bone, develops originally from connective tissue, which changes first into cartilage and later into bone. This primary endochondral bone is replaced everywhere else in the body by lamellar bone around Haversian canals, but in the endochondral layer of the capsule it persists and is characterized by its weblike strands and the cartilage islands that remain embedded in it. The author agrees with Bast that the fissula ante fenestram represents an area of unstable bone. He suggests that, since the main blood supply of this area is from the middle ear, abnormal developments may occur in it as a result of disease of the middle ear. Thus otosclerosis may be regarded as an inherited susceptibility to environmental influences.

Ruttin⁷ reports the unusual finding of a bilateral fistula symptom in a case of otosclerosis. There seemed no doubt concerning the accuracy of the diagnosis of otosclerosis, the clinical picture being typical. The author suggests that the otosclerotic process had destroyed the bone

7 Ruttin, E. Ueber Fistelsymptom bei Otoklerose, *Pract oto-rhino-laryng* 1 410-415, 1938.

around the oval window replacing it with connective tissue, thus rendering the stapes abnormally mobile

[Comment How does the author explain the deafness if the stapes was still mobile?]

Sommerfeld,⁸ impressed by the apparent relation between otosclerosis and the "pregnancy hormones" (suggested by such factors as the predominance in females and the influence of pregnancy and the menopause), injected the urine from pregnant women into 3 guinea pigs. Comparing the labyrinthine capsules of these guinea pigs with those of controls he observed incomplete ossification with large cartilage nests and marked vascularity of the endochondrial layer in the guinea pigs which received the injection. He wisely concludes that further confirmation and study are needed before any conclusions can be drawn.

Treatment—A valuable and significant study of the results of treatment of otosclerosis is contributed by Suggit.⁹ Having previously obtained some improvement in hearing in a proportion of cases of otosclerosis by the intratympanic injection of thyroxin or physiologic solution of sodium chloride, he checked his results by injecting the latter through the eustachian tube in 11 cases of otosclerosis while 15 cases of otosclerosis were simultaneously observed audiometrically without any treatment. Improvements in hearing occurred with equal frequency in both groups of cases and averaged up to 10 decibels throughout the tonal range. Since no greater improvement was obtained by the intratympanic injection of thyroxin than by the use of physiologic solution of sodium chloride or by no treatment at all, the author concludes that intratympanic medication for otosclerosis has no real value and that any apparent results are within the limits of normal variation. He contends that "No treatment of otosclerosis can be considered of value unless it can produce a sustained improvement greater than ten decibels over the greater part of the range, 64 to 8,192 d v s."

Goldstein¹⁰ reports his results with intratympanic injection of thyroxin for a series of 42 otosclerotic patients during the past three years. The technic described by Gray was followed in every detail. Of the 42 patients, 9 showed no improvement, 10 showed comparatively slight changes with recession six months later, and 23 showed in the audiogram definite improvement maintained six months after treatment.

8 Sommerfeld, W. S. À propos de l'otospongiose et de l'influence des hormones de la grossesse sur la capsule osseuse labyrinthique des cabayes, *Rev de laryng* **58** 389-391 (April) 1938.

9 Suggit, S. Observations on the Variation in Hearing in Otosclerosis, *J Laryng & Otol* **53** 294-312 (May) 1938.

10 Goldstein, M. A. Thyroxine Therapy in Otosclerosis. Report of Forty-Two Cases, *J Laryng & Otol* **53** 444-457 (July) 1938, *Laryngoscope* **48** 443-457 (July) 1938.

[Comment These results are at variance with the negative results reported by Livingstone, who continued Gray's series of cases after the latter's death, and by Suggit, who used controls in the form of patients treated with physiologic solution of sodium chloride and others receiving no treatment (see the articles reported earlier in this review and in the review for 1937) On examining the author's results more closely, one finds that audiogram readings before and after treatment are given for 8 of the 23 patients that were improved Presumably these were the best 8 Analysis of the hearing for the frequencies of 512 1024 and 2048 discloses an average change of less than 10 decibels for 4 of the 8 patients, and this change was a loss as often as it was a gain Of the remaining 4 patients, only 1 experienced an improvement of more than 10 decibels in both ears (in each case both ears were treated), and this patient had definite hypothyroidism It seems likely that the results reported by the author lie within the limits of normal variation with but few exceptions and that several of these exceptions were in definitely hypothyroid patients, so that the possibility that absorption of thyroxin into the system caused the improvement in hearing cannot be excluded entirely]

A few more reports on the medical treatment of otosclerosis may be briefly mentioned Kobrak¹¹ believes that in a certain proportion of cases otosclerosis is due to spasmophilia of the muscles of the middle ear At first there is rigidity of the stapes and later an ankylosis secondary to the spasm of the muscles [On the basis of his rather fanciful theory] the author suggests the use of calcium, phosphorus, vitamin D and parathyroid extract in these cases of otosclerosis

Maggiorotti,¹² regarding ankylosis of the stapes as a joint disease, has used daily intramuscular injections of a glycerophosphate solution which is used for arthropathies The results as far as the tinnitus is concerned are stated to be encouraging

Desjardins¹³ revives the use of roentgen rays for otosclerosis Ostensibly in many cases otosclerosis was favorably influenced

Seiferth¹⁴ (in one instance with the coauthorship of Kolb) contributes two more articles on the treatment of otosclerosis with a deriva-

11 Kobrak, F Pathologische Physiologie als Bundlage praktischer Ohrenheilkunde I Zur pathologischen Physiologie der Otoklerose (Die spasmophile Form der Otoklerose), *Pract oto-rhino-laryng* **1** 186-202, 1938

12 Maggiorotti, U Terapia dell'otospongiosi con le alte dosi di glicerofosfato Nota preventiva, *Valsalva* **14** 48-49 (Jan) 1938

13 Desjardins, A U Action des rayons X et du radium sur l'oeil et l'oreille, *J de radiol et d'electrol* **22** 305-317 (July) 1938

14 Seiferth, L B Ueber die Atiologie und Behandlung der Otoklerose, *Arch f Ohren-, Nasen- u Kehlkopfh* **144** 367-383, 1938 Seiferth, L B, and Kolb, H Ueber die Atiologie und Pathogenese der Otoklerose auf Grund tiereperimentellen Versuche mit A T 10 Ein Beitrag zur experimentellen Otoklerose, *ibid* **145** 391-419, 1938

tive of ergosterol, dihydrotachysterol. He believes that he has shown that the calcium content of the blood is slightly increased in otosclerosis. Furthermore, on feeding this drug to dogs the author observed foci in the temporal bone, chiefly in the external bony canal and outer wall of the middle ear, resembling otosclerosis.

Escat¹⁵ has employed phosphorus therapy for otosclerosis for many years and since 1913 has added pituitary extract on the theory that the hypophysis is the controlling gland of the endocrine system. Of 223 patients so treated, 98 were unchanged, 78 slightly improved and 28 markedly improved, while 19 became worse in spite of treatment. On the theory that the ovaries influence otosclerosis, he also irradiates the ovaries in certain cases with good results. [Since his results, like those of the preceding four authors, were not controlled audiometrically, they must be taken with reservations and regarded as lying within the normal limits of variability of the disease.]

Hughson¹⁶ reports his results in 18 cases of deafness treated by blocking the round window niche with a tissue graft. All but 2 of these have been observed for three or more months after operation, the longest period of observation being twenty months. In no case has the hearing been further impaired by operation except for a brief period immediately postoperatively. In 2 of the 18 improvement was not shown, while in the remainder improvement occurred sometimes immediately and sometimes one to seven months after operation. The average improvement in all 18 cases was 10 decibels for the critical frequencies, a maximum improvement of 20 decibels being obtained in 1 case. Nerve and conduction deafness are equally suitable for this operation. In the discussion that follows this paper, D. E. S. Wishart points out that the author measures improvement by taking the best reading for each tone from a large series of audiograms. When the audiogram taken before operation is compared with the last audiogram, in no case was there either an improvement or an impairment greater than 10 decibels, and this lies within the normal variation. In comparing the ear operated on and the other ear, the same degree of change was observed in both ears in 7 of 8 cases, indicating that the patients' hearing had not been altered by the operation.

Sourdille¹⁷ describes his present technic in the surgical treatment of otosclerosis, which is essentially the same as in previous articles,

15 Escat, A. *Thérapeutique anti-dysovarique de l'otospongiose*. Opothérapie hypophysaire. Radiothérapie ovarienne, *Ann. d'oto-laryng.*, October 1938, pp. 921-928.

16 Hughson, W. Symposium. What Can Be Done for Chronic Progressive Deafness? Rationale, Technique, Case Reports and Observations with Grafts in the Round Window, *Laryngoscope* 48: 533-551 (Aug.) 1938.

17 Sourdille, M. The Present Position of the Surgical Treatment of Otosclerosis, *J. Laryng. & Otol.* 53: 78-83 (Jan.) 1938.

mentioned in this review for 1937 namely, a three stage procedure. The first stage consists of the removal of the skin from the outer two thirds of the posterosuperior bony canal, allowing the surface to become covered with an epithelized scar. In the second stage mastoidectomy is carried out with removal of the head of the malleus and of the superior bony wall of the canal. The cicatricial tissue from the first operation is used to cover the incus and close the aditus to the horizontal semicircular canal. In the third stage the cicatricial flap is elevated from the semicircular canal, which is now opened with great care so as not to injure the delicate membranous labyrinth. The flap is then replaced over the fistula and acts as an extension of the tympanic membrane. The improvement in hearing is due, the author believes, to the transmission of vibrations from the drum membrane to the labyrinthine fistula, analogous to the normal physiologic process. If the fistula ossifies, a secondary operation is necessary to remove the new bone and restore the hearing. The hearing is, as a rule, definitely improved by this operation up to 10 or 20 times better than before. A contraindication is a dense mastoid or pneumatization of the zygoma, since opening the zygomatic cells is difficult and is often followed by infection and necrosis of the incus.

[Comment. The best criticism of Sourdille's reports is given by Holmgren in the article reviewed immediately after that of Ledoux.]

Ledoux¹⁸ calls attention to the great technical difficulties of Sourdille's operation for otosclerosis. The resection of the head of the malleus in the second stage requires extraordinary skill. The author suggests that by waiting until the third stage, when the malleus is firmly fixed by the skin flap, the head may be resected without the fear of luxation. The author states that simple opening of the labyrinth without disturbing the ossicles will arrest the progress of otosclerosis in early stages with slight deafness.

[Comment. There is as yet no proof that opening the labyrinth will arrest the progress of the deafness in otosclerosis.]

Holmgren¹⁹ presents the most complete discussion to date of his own work on the surgical treatment of otosclerosis. Between 1920 and 1935 he operated on 35 patients with otosclerosis by the following technic. After a preliminary radical mastoid operation with exposure of the horizontal semicircular canal, a fistula was made into the labyrinth in the early cases in the promontory, in the later cases into the horizontal canal, and covered with mucoperiosteum. The primary result on hearing was good but in every case there was no permanent result, since the fistula became covered with bone. In 1935 a Thiersch graft was used to cover the fistula and in 1 case gave a good permanent result.

18 Ledoux. Remarques techniques a propos de l'operation de Sourdille, Bull Soc belge d'otol, rhin, laryng, 1937, pp 310-313.

19 Holmgren, G. The Surgical Treatment of Otosclerosis, Hygiea 100 681-723 (Oct 8), 757-770 (Oct 15) 1938.

but the wide opening to the outside was troublesome. Therefore, he next covered the fistula with a small strip of fat with a piece of gold leaf intervening to prevent adhesion to the membranous labyrinth. However, although the immediate improvement in hearing was marked, it was not lasting, and reoperation showed new bone covering the fistula. Lately the author has done the operation in two stages. In the first the horizontal canal is trimmed down almost to the lumen and the wound filled with paraffin and sutured. In the second stage the layer of connective tissue that forms over the horizontal canal is used as a flap to cover the fistula. In several cases the fistula remained open, in others it has closed. Because fistulas due to cholesteatoma do not close, the author has covered those in his last 2 cases with the squamous epithelium of a previously created radical cavity. It is too recent to judge the final result.

Since the fistulas close so readily the author states that several fistulas should be made in each case, so that he usually makes a fistula into two or more canals. To avoid injury to the membranous labyrinth the fistula is made as close to the concavity as possible, where the membranous labyrinth lies away from the bony wall. Decompression of the endolymph exposing the saccus endolymphaticus also is done, on theoretic grounds.

At the moment a fistula is made the hearing is considerably improved. In the first days after operation the hearing decreases, and then, when the result is favorable, it increases again. As regards the permanent results, the author states that, since ossification of the fistula usually occurs and no method of preventing it has been found, the good initial result is only temporary in a great number of cases and that occasionally the hearing is worse than before operation.

The author emphasizes that audiometric testing must be used to follow the hearing. Sourdille's published results are severely criticized because of the absence of audiometric determinations and because of the way in which improvement of hearing was measured. Thus, a change from perception of the conversational voice close to the ear to perception at 5 to 10 cm from the ear is called by Sourdille 5 to 10 times better hearing, while if it is perceived at 20 cm he considers the patient to hear 20 times better. While one must assume from the degree of improvement in hearing that the fistula has remained open in several of Sourdille's cases, the claim of 74 per cent favorable results is not justified by the published records.

Nager²⁰ described the histologic observations on a patient who had had an operation for otosclerosis by Holmgren²¹ four weeks before

20 Nager. Demonstration der Schmitte einer Patienten mit Otoklerose, *Acta oto-laryng* 26:342 (July) 1938.

21 Holmgren, G. Ein operierter und an intercurrenter Krankheit gestorbener Fall von Otoklerose, *Vorläufige Mitteilung*, *Acta oto-laryng* 26:340-342 (July) 1938.

death A woman of 45 with otosclerosis showed reduction of hearing for the conversational voice to 0.2 meter from the right ear and 0.3 meter from the left ear The left ear was operated on, fistulas being made into the horizontal and posterior semicircular canals and gold leaf and then fat being used to cover the fistulas The hearing immediately improved to more than 10 meters and the next day to 35 meters It then gradually decreased to 6 meters on the fourth postoperative day, 1 meter on the sixth day and 0.5 meter on the twelfth postoperative day The patient died of a pulmonary embolus twenty-seven days after operation

Histologic examination showed active otosclerosis with a rich vascular supply and osteoclasts The operatively created fistulas were partly open but were partly bridged over by osteoid substance, which projected over from the periosteal capsule into the operative cavity The membranous canal was completely preserved, and the endolymph was only slightly more deeply stained in the canals than elsewhere in the labyrinth The operative cavity in the mastoid was free from inflammation The author emphasizes the absence of signs of inflammation in the labyrinth four weeks after fistulization

[Comment Neither Holmgren's nor Sourdille's articles present anything not in their previous reports Holmgren admits that a permanent improvement in hearing after his operation is the exception, and he ascribes his failures to regeneration of bone, which closes the fistulas Sourdille claims good results from his three or four stage operation, requiring several months between each stage, partly for the infection to subside However, Sourdille's results have always been obscured by his method of reporting improvement, by his refusal to allow any one to see him operate or to examine any but an exceptional patient and by his failure to record the hearing audiometrically before and after operation One must conclude, with Holmgren, that Sourdille probably has an occasional permanent fistula with permanent improvement in hearing but that with the available evidence one cannot accept his claim of 74 per cent positive results]

Lempert²² reports his results for 23 patients with otosclerosis operated on by a new surgical procedure The operation is described in the minutest detail with illustrations depicting each step The endaural approach to the temporal bone previously described by the author is employed with the area under local anesthesia The operation consists essentially in creating a fistula into the horizontal semicircular canal and covering the fistula with a plastic flap consisting of the skin of the superior and the posterior bony wall of the canal intact with Shrapnell's

²² Lempert, J Improvement of Hearing in Cases of Otosclerosis A New, One Stage Surgical Technic, *Arch Otolaryng* 28 42-97 (July) 1938

membrane and the pars tensa. A series of 23 patients operated on by this method is reported in detail with audiograms before and after operation. Four patients had poor bone conduction before operation (indicating loss of nerve function) and the hearing was not improved. In 1 of the 4 the fistula began to show signs of closure at the end of ten days and was completely closed in three weeks (as evidenced by disappearance of the reaction to the fistula test). In 22 patients the fistula remained open and the reaction to the fistula test remained positive to the lightest pressure of a cotton-tipped applicator. The first patient reported on was operated on seven months before the report was made, while the most recent operation was one month before. On the basis of previous experience, before the operation was perfected, the author has found that when regeneration of bone takes place to close a fistula it does so immediately after operation so that by four weeks after operation the reaction to the fistula test becomes negative. When regeneration of bone has not occurred two months after operation, the author believes that the fistula will remain permanently open.

[Comment. Examining the published audiograms, the degree of improvement in hearing in the 19 patients with positive results leaves little doubt concerning the value of this operative procedure in the author's hands. Contrasted to an improvement of less than 10 decibels which characterizes, with rare exceptions, previous reports of the results of treatments of otosclerosis, one sees an improvement for the critical frequencies of 512, 1024, and 2048 that averages 21.4 decibels for the 19 patients reported as experiencing good results. In a number of the cases, however, the opposite ear also showed some improvement and in 1 case it showed more improvement than the ear operated on (case 15).]

Those who have observed the author's patients and who have seen him perform the operation are impressed by the degree of improvement in hearing experienced by the patients, which leaves no doubt concerning the validity of the author's results. The operative procedure itself gives an end result that anatomically is similar to that aimed at by Sourdille, with the important differences that the Lempert operation is a one stage procedure and that the end results obtained by Lempert are positive in a far larger proportion of cases than are those obtained by Sourdille, though comparisons are difficult because of Sourdille's obscure reports. Finally, the complete freedom from postoperative infection in Lempert's cases is in marked contrast to the infection that occurs as a rule in Sourdille's cases, judging by his description. The difference is evidently one of technic, since Lempert employs the most meticulous surgical asepsis, both in his operation and in the postoperative care.

The technical proficiency displayed by Lempert in his operating is an important factor in his results. The creation of the plastic flap without

tearing the delicate attachment of the skin to Shrapnell's membrane is a difficult technical accomplishment. The creation of the fistula without injuring the membranous labyrinth also is a delicate procedure, requiring unusual skill. In the final analysis, the results obtained by Lempert, which have never before been approached, are due to his success in maintaining the patency of the fistula. Further investigation is necessary to show whether it is the use of the polishing burr in making the fistula, the use of Shrapnell's membrane to cover the fistula or both that is responsible for its permanence.]

LABYRINTHINE DEAFNESS

Pathology of Nerve Deafness—From the otologic laboratory at Johns Hopkins University comes an important study of the histologic findings in a series of cases of perception deafness with loss for the low tones as well as for the high tones. A total of 35 ears was examined histologically by Oda.²³ In each case there was slight to moderate impairment of the hearing for low tones, with marked impairment in most cases for the tones above 1024 vibrations. In each case the 512 vibration tuning fork was heard longer by air than by bone conduction indicating inner ear deafness. As controls, the author used patients with normal hearing and patients with impairment for high tones only making observations on the middle ear and the cochlea. In 4 of the 35 ears no lesion was found greater than those in the controls. The author explains this on the basis of limitations of histologic technic or the possibility of central deafness. Of the 35 ears, 14 showed an abrupt drop in perception for the high tones, and 13 of the 14 were found to have atrophy of the organ of Corti in the basal turn. There were 15 ears with a gradual loss of hearing for the high tones, and in all 15 atrophy of the spiral ganglion cells and nerve was noted. These observations are in harmony with those reported in the previous studies of Crowe, Guild and Polvogt, who found these two types of histologic change in these two varieties of nerve deafness for high tones. In 6 ears the audiogram taken before death was of the horizontal type, and in all 6 the prominent lesion was in the middle ear. In none of the 35 ears were there signs of past or present inflammation in the cochlea, the changes being purely atrophic. The author concludes that impairment of hearing for low tones with a positive reaction to the Rinne test is in most cases due to the same changes as impaired hearing for high tones, namely, atrophy of the organ of Corti in the basal turn. It was not possible to demonstrate atrophic changes in the apical turns which could be held responsible for the loss of hearing for low tones. In the 6 ears with the horizontal

23 Oda, D. Observations on the Pathology of Impaired Hearing for Low Tones, *Laryngoscope* 48 765-792 (Nov.) 1938

type of audiogram a lesion of the middle ear was combined with that of the inner ear. The author believes that while the tone of 8192 is heard in the middle of the lower basal turn, 4096 in the upper end of the lower basal turn and 2048 in the lower part of the upper basal turn, the area for the hearing of lower frequencies is not restricted.

[Comment The author's findings are in harmony with clinical experience in that nerve deafness is usually permanent. However, there is another type of nerve deafness for low tones, with which the hearing may show remarkable improvement, namely, that in Ménière's syndrome (to be discussed later). This condition must be due to some other type of pathologic change than that described by the author, since an atrophic nerve or organ of Corti could not be expected to regenerate. The pathologic nature of nerve deafness for low tones that is subject to fluctuations and is accompanied by vertigo and diplacusis remains to be discovered.]

Crowe and Guild²⁴ report the case of a child with impairment of hearing due to hypertrophy of lymphoid tissue around the eustachian orifice, radiation of the nasopharynx resulted in restoration of hearing to normal. Because the audiogram taken before treatment revealed a loss for high tones greater than that for low tones while after treatment the hearing was normal for all tones, the authors conclude that a purely conductive lesion (occlusion of the eustachian tube) may cause a greater loss for high than for low tones, contrary to the usual teaching.

[Comment I pointed out several years ago, and again last year, that occlusion of the eustachian tube resulting in fluid in the middle ear caused a loss for high tones as well as for low tones, due presumably to blocking of the round window, through which high tones are probably heard, in addition to the blocking of the oval window, through which low tones are conducted. When the oval window alone is occluded, as in otosclerosis, the hearing for high tones remains relatively close to normal, since high tones continue to enter the round window normally, whereas the perception of low tones is markedly impaired. The case reported confirms my previous observation.]

Crowe²⁵ calls attention to the two practical applications of histologic study in cases of nerve deafness. When the loss of hearing begins at 256 or 512 vibrations and increases gradually toward the higher tones, the lesion is atrophy of the cochlear nerve supplying the basal turn of the cochlea, and the organ of Corti is not affected. When the audiogram shows an abrupt or sharply localized impairment of perception for high

²⁴ Crowe, S. J., and Guild, S. R. Impaired Hearing for High Tones, *Acta otolaryng* **26** 138-144 (March) 1938.

²⁵ Crowe, S. J. Diagnosis and Differential Diagnosis of Deafness, *Arch Otolaryng* **28** 663-675 (Nov.) 1938.

tones, both the nerve and the organ of Corti in the basal coil are atrophic. The author states that the cause of these two types of lesions is unknown.

[Comment The excellent work of Bunch on traumatic nerve deafness reported in this review last year indicates that the sharply localized impairment of perception for high tones with atrophy of the organ of Corti and the nerve is the result of exposure of the ear to loud sounds, usually over a prolonged period.]

Shambaugh²⁶ reports a series of 9 cases of perception deafness with diplacusis. In 1 the condition was apparently the result of a hemorrhage into the labyrinth, the diplacusis being due, the author suggests, to fibrin or red cells adhering to the vibrating membrane in the cochlea. In 1 case perception deafness with diplacusis resulted from serous labyrinthitis complicating acute suppurative otitis media. In 7 cases the condition was characterized by fluctuating deafness usually with repeated attacks of vertigo. The author suggests that in this group there may be inflammatory labyrinthitis without suppuration of the middle ear but due to a focus of infection. The similarity to iritis was pointed out.

Hereditary Nerve Deafness—Again the German literature is filled with articles on the differential diagnosis of hereditary and acquired deaf-mutism, a matter of considerable importance because of the law requiring the sterilization of those with hereditary deafness. Eschweiler²⁷ studied the hearing remnants in deaf-mute children between 12 and 15 years of age. He concludes that sterilization can be advised only with a family history of deafness. He agrees with Langenbeck that asymmetric hearing remnants indicate acquired deafness and symmetric remnants hereditary deafness. Along with the asymmetric hearing remnants in acquired deafness there is often asymmetry of the vestibular reactions.

Steinberg²⁸ advances the view that sterilization should not be required in otosclerosis but that it should be permitted in the interest of the patient, since pregnancy accelerates the process. Moreover, an otosclerotic person should not marry a person with a family history of otosclerosis, nor should relatives with otosclerosis in their family marry.

Luscher²⁹ studied 5 temporal bones from 3 patients with endemic deaf-mutism and found pathologic changes chiefly in the middle ear,

26 Shambaugh, G. E., Jr. Recent Advances in the Diagnosis and Treatment of Deafness, *Ann. Otol., Rhin. & Laryng.* **47** 636-648 (Sept.) 1938.

27 Eschweiler, H. Hunderd Erbgutachten aus der Taubstummenanstalt Leipzig, *Ztschr. f. Hals-, Nasen- u. Ohrenh.* **43** 231-249, 1938.

28 Steinberg, G. Ueber die Schwierigkeit der Diagnose und Beurteilung familiärer Schwerhörigkeit, *Ztschr. f. Hals-, Nasen- u. Ohrenh.* **43** 501-524, 1938.

29 Luscher, E. Drei Fälle von endemischer Taubstummheit, *Schweiz. med. Wchnschr.* **68** 835-838 (July 16) 1938.

consisting of an increase in the periosteal layer over the promontory, narrowing the oval window slightly and almost completely closing the round window niche. The inner ear and ossicles were normal.

[Comment If deaf-mutism results from blocking the round window niche, as it seemed to in these cases, then one would expect that the operation suggested by Hughson would further impair rather than improve the hearing.]

Traumatic Nerve Deafness—Caroggio³⁰ observed 15 cases of injury to the inner ear after work in compressed air. In all cases the symptoms occurred after decompression, from a few minutes to about one hour after return to normal atmospheric pressure. The duration of the latent period has no relation to the degree of damage. The typical syndrome is severe vertigo accompanied by falling and a dimming of consciousness, tinnitus and deafness. Nystagmus is often horizontal-totary and directed toward the normal or less affected ear. The acute stage lasts about one week. In favorable conditions the vertigo and imbalance disappear gradually. Deafness varies from simple hypoacusis to complete deafness, and in 50 per cent of cases recovery is only partial. Vestibular hyporeactivity is found with the deafness.

Molan,³¹ on the basis of experimental and histologic studies, believes that noise produces damage chiefly to hearing by air conduction but that that by bone conduction cannot be entirely excluded. The most injurious tone is that heard best by the human ear, namely, 2300 vibrations. An irregular noise is much more injurious than a uniform noise.

Tanturri³² found a localized loss of hearing for tones around c-5 in 55 of 1,500 patients examined. He suggests that quinine, syphilis, trauma to the skull, nicotine and cocaine may be responsible for this.

[Comment Bunch has fairly conclusively demonstrated that these localized dips at c-5 are usually the result of acoustic trauma.]

Bunch³³ observed a man of 22 who noted marked deafness in one ear immediately after a firecracker exploded close by. Audiometric tests showed a pronounced loss of perception for tones above 512 vibrations in this ear, with a positive reaction to the Rinne test, decreased bone conduction and perception in the Weber test referred to the left ear. Two days later the hearing had nearly returned to normal, there being only a dip of 45 decibels at 4096 vibrations. [The author does not hazard a guess as to the pathologic nature of this temporary loss.]

30 Caroggio, L. Lesioni cocleovestibolari nella malattia dei cassoni, *Atti Soc. ital. di laring.* (pt. 2), 1937, pp. 214-215.

31 Molan, A. Otopatie da rumori, *Atti clin. otolaring.*, Torino, 1938, pp. 372-389.

32 Tanturri, V. Osservazioni sull'ipoacusia localizzata, *Rassegna ital. di otorino-laring.* 12: 195-215, 1938.

33 Bunch, C. C. Traumatic Deafness from the Explosion of a Firecracker. A Case Report, *Ann. Otol., Rhin. & Laryng.* 47: 1092-1095 (Dec.) 1938.

Nerve Deafness from Drugs—Considerable interest continues to be shown in the effect of quinine on the hearing. Covell³⁴ studied the endings of the cochlear nerve in the hair cells by dissecting the membranous labyrinth of guinea pigs and placing the fragments in a dilute solution of methylthionine chloride (methylene blue). The hair cells of animals that were given three injections of quinine over ten days showed swelling of the nerve ending in the cell, followed later by a granular break-up of these endings, with deeper than normal staining. Marked degenerative changes in the cytoplasm also were seen in many of the hair cells from the treated animals. Not all the hair cells of one cochlea showed the same degree of change, but the changes were, on the whole, more pronounced toward the lower half of the cochlea. The author suggests that these findings, which are not demonstrable in ordinary histologic preparations, may represent one of the earliest alterations in the neural mechanism for the transmission of impulses.

Covell³⁵ measured the area of the stria vascularis as a whole compared with the vascular areas alone in the midvertical section of the cochlea in guinea pigs given injections of quinine, sodium salicylate, codeine or soluble barbitol daily for thirty-six to fifty-seven days. A significant increase in the vascular areas was found in the animals treated with quinine and with sodium salicylate, codeine resulted in a slight increase, while soluble barbitol produced a very slight decrease, probably of no significance. The author suggests that the vascular stasis induced by quinine and salicylates results in deficient nourishment of cochlear structures and might alter the intracochlear fluid pressure. In addition to the possible impairment of nutrition from vascular stasis, these drugs probably also are direct protoplasmic poisons.

Covell³⁶ summarizes the results of several years of experimental study of the effects of quinine and salicylates on the cochlea. The vessels of the stria vascularis were found to be definitely dilated. The mitochondria of the cells of the stria vascularis revealed degenerative changes in pregnant guinea pigs and even greater changes in the fetal guinea pigs. The cells of the external sulcus were swollen and vacuolated but without mitochondrial damage. Degenerative changes in the external hair cells, consisting of vacuolation, distortion and transformation of the fine rodlike mitochondria into dioplets, were commonly found, the internal hair cells being more resistant. The myelin sheath

34 Covell, W. P. The Peripheral Endings of the Cochlear Nerve, *Ann Otol, Rhin & Laryng* **47** 63-67 (March) 1938.

35 Covell, W. P. Histopathology of the Peripheral Auditory Mechanism in Drug-Injected Animals, *Ann Otol, Rhin & Laryng* **47** 342-346 (June) 1938.

36 Covell, W. P. Effects of Drugs on the Stria Vascularis, *Arch Otolaryng* **27** 438-443 (April) 1938.

of the cochlear nerve is exceptionally unstable, and degenerative changes in it are produced by a variety of factors, even control animals showing some changes but not as extensive as those in the drug-treated animals. Changes in the cells of the spiral ganglion, with vacuolation of the cytoplasm, loss of the chromophilic substance and tendency to displacement of the nucleus occurred with quinine and salicylates and were more severe after administration of salicylates.

The author concludes that quinine and salicylates act not alone on the vascular supply of the cochlea but on the entire structure. Any one of the many changes described might cause an impairment in hearing.

Mosher³⁷ gave an average of 20 grains (1.3 Gm.) of quinine to 11 pregnant guinea pigs in one to ninety-two doses and obtained from them 23 fetuses for study. Three pregnant guinea pigs were given sodium salicylate, from 20 to 35 grains (1.3 to 2.3 Gm.), and yielded 7 fetuses for study. One adult was given mapharsen, and its fetus was studied. Six adults were used as controls.

Histologic study of the temporal bones from these animals showed small hemorrhages into the cochlea, most often into the scala tympani of the basal whorl. Of 5 adult controls, 4 showed slight hemorrhages into the cochlea but, as a rule, the hemorrhages were more extensive after administration of quinine and were associated with marked congestion of the cochlear blood vessels. Mapharsen and sodium salicylate resulted in similar changes in the fetus and the adult except that mapharsen resulted in hemorrhages into the scala vestibuli, vestibule and semicircular canals rather than the scala tympani, suggesting that quinine and mapharsen may have a selective action on different parts of the inner ear.

Falbe-Hansen³⁸ gave 4 or 5 grains (0.26 or 0.32 Gm.) of salicylates a day to 41 patients, and 33 of these showed definite diminution of hearing, as well as vestibular symptoms and tinnitus. After stopping the medication complete recovery occurred. Quinine, 80 to 150 cg., was given to 21 patients, all of whom showed deafness, tinnitus and vertigo with nystagmus. Patients with aural disease were especially sensitive to quinine. The author points out the great similarity between these symptoms and Ménière's disease and suggests that in both instances the same cause is present, namely, edema of the labyrinth. By dehydration the author improved patients with Ménière's disease and by hydration he brought back the symptoms. He suggests that the loss of hearing from quinine and salicylates may be due to capillary injury and edema.

37 Mosher, H. P. Does Animal Experimentation Show Similar Changes in the Ear of Mother and Fetus After the Ingestion of Quinine by the Mother? *Laryngoscope* 48:361-395 (June) 1938.

38 Falbe-Hansen, I. Osservazioni cliniche e sperimentali sull'influenza dei salicilati e del chinino sull'organo dell'udito, *Rassegna ital. di oto-rino-laring.* 12:81-86, 1938.

Chryssicos and Yanoulis³⁹ studied 28 persons who had taken huge doses of quinine with suicidal intent (as high as 16 grains [1 Gm]) Extraordinarily loud tinnitus was always present, and objectively there was perception deafness, which was never permanent. There were vertigo, nystagmus, falling and nausea. The galvanic and caloric reactions were always reduced. A new symptom also was observed in a series of such cases, namely, congestion of the drum membrane and in 1 case acute exacerbation of chronic otitis.

[Comment: It is surprising that there was no permanent defect in hearing after these huge doses of quinine. Perhaps prolonged medication is more apt to lead to permanent deafness than is one large dose.]

There is an interesting report from Farquharson⁴⁰ of deafness in a dog as a result of oil of chenopodium administered for worms. A total dose of 1.5 cc. in a capsule was given.

Chavanne⁴¹ has observed 3 cases of transitory deafness after the injection of antityphoid vaccine. Three antidiphtheritic injections were given a child, and after each injection the child vomited, was feverish and complained of headache and defective hearing on the right side. Eight months later reexamination showed inner ear deafness on the right side. The author advises withholding further injections when such symptoms occur after vaccination.

Nerve Deafness from Infections—A study of the hearing and vestibular apparatus in 115 children in the institute for the deaf and dumb in Leningrad and of 18 children hard of hearing from cerebrospinal meningitis was carried out by Bubes.⁴² Loss of vestibular function was found in 91 per cent of all the cases, 81 per cent showing complete absence of response and 10 per cent diminution of response. On the other hand, complete deafness was found in only 31 per cent of the children in the institute. In the 18 children hard of hearing from cerebrospinal meningitis, the vestibular response was completely lost in 13, diminished in 3 and normal in 2. Especially noteworthy were 4 subjects with normal hearing in one ear and complete loss of vestibular function in both ears. The author concludes that in cerebrospinal meningitis the vestibular apparatus has a greater tendency to be damaged.

39 Chryssicos, J., and Yanoulis, G. L'influence de la quinine a hautes doses sur le labyrinthe, *Presse med* **46** 1877-1878 (Dec 21) 1938.

40 Farquharson, J. Deafness Due to Toxicity of Oil of Chenopodium, *J Am Vet M A* **93** 329 (Nov) 1938.

41 Chavanne, F. Un cas de surdite unilaterale consecutive a la vaccination antidiphtherique, *Oto-rhino-laryng internat* **22** 481-482, 1938.

42 Bubes, G. F. Zur Frage der Affektion des Gehororgans bei der epidemischen cerebrospinalen Meningitis, *Vestnik otol* **2** 217-218, 1938.

than the cochlear, resulting in the so-called paradoxical injury to the ear, in which the phylogenetically older vestibular apparatus is more damaged than the newer cochlea

Toglia⁴³ discusses the different theories explaining the occurrence of deafness after mumps. Toxic labyrinthitis, suppurative labyrinthitis via the glaserian fissure and the middle ear and metastatic infection such as occurs in the ovaries, pancreas and testes have all been suggested. Lately the theory of meningoencephalitis due to a neurotropic toxin has gained ground. While meningeal symptoms in epidemic parotitis are relatively rare, there are always slight changes in the cerebrospinal fluid, indicating a meningeal or encephalitic reaction. Apparently the virus fixes directly in the central nervous system at the onset of the disease.

Loebell⁴⁴ reports a case of multiple recurrent osteomyelitis in which vertigo, vomiting and headaches developed and four weeks later defective hearing in one ear.

MacCready⁴⁵ describes the interesting case of a boy of 15 who was given a prophylactic dose of 3,000 units of tetanus antitoxin intramuscularly. Nine or ten days later he looked feverish, swelling of the right arm developed, and he was dizzy. Five days later these symptoms had subsided, but he awoke deaf. The hearing has remained stationary since then (one year). Examination shows inner ear deafness with a greater loss of hearing for high tones, the loss being 46 per cent in the right ear and 45 per cent in the left ear for the conversational tones. The author believes that the symptoms were the result of an anaphylactic reaction in both eighth nerves.

[Comment: Since anaphylaxis occurs only in certain animals and probably not at all in man, it would be more accurate to call this an allergic reaction of some sort, probably similar to serum disease, which may cause severe neuritis.]

Leicher⁴⁶ reports 5 cases of deafness following food poisoning. In the first the patient became deaf in the right ear with tinnitus and vertigo a few days after gastrointestinal symptoms caused by eating vanilla ice cream. The next 3 cases were those of a father, mother and son all ill with gastrointestinal symptoms after eating a meat salad with mayonnaise. In the son spontaneous nystagmus and bilateral nerve deafness developed, the father showed caloric hyperirritability and slight

43 Toglia, C. Sordita da parotite epidemica, *Rinasc. med.* **15** 655-656 (Oct 15) 1938.

44 Loebell, H. Sulla sordità da osteomielite, *Rassegna ital. di oto-rinolaring.* **12** 31-37, 1938.

45 MacCready, P. B. Inner Ear Deafness from Tetanus Antitoxin Injection, *Ann. Otol., Rhin. & Laring.* **47** 247-252 (March) 1938.

46 Leicher, H. Neuritis nervi octavi durch Nahrungsmittelvergiftungen, *Hals-, Nasen- u. Ohrenarzt* (pt. 1) **29** 104-107 (Feb) 1938.

transitory nerve deafness, while the mother showed disturbance of the right vestibule. In the fifth case gastrointestinal symptoms developed after the eating of ham. There were vertigo, headache, tinnitus on the left, deafness and absence of vestibular response. A year later the vestibular response on the left side had returned but this ear was still deaf.

[Comment: The organism causing the 3 attacks in the same family must have created a toxin with an affinity for the eighth nerve.]

König⁴⁷ studied a large series of patients to see how often defects of hearing following diphtheria, scarlet fever and measles are the result of toxic neuritis of the inner ear. Among 1,602 patients with diphtheria there were 117 with otitis, and 8 of these remained deaf because of a conduction defect. In no case could true toxic neuritis of the eighth nerve be demonstrated, although other neural disturbances, such as paralysis of the palate, larynx or ocular muscles, were fairly frequent. Among 995 patients with scarlet fever there were 177 with otitis, of whom 15 remained deaf. Among 671 patients with measles there were 140 with otitis, of whom 7 remained deaf. In each case deafness from measles or scarlet fever was of conduction type, and no case could be regarded as one of toxic neuritis. The author concludes that while toxic neuritis of the nerve of hearing may occur after diphtheria, scarlet fever or measles, it is certainly rare and is probably due to abnormal sensitivity of the nervous apparatus.

[Comment: These findings differ from the results of the statistical study in the schools for the deaf carried out several years ago, in which most of the acquired deafness appeared to be due to toxic neuritis from these infections without otitis media.]

Three articles report cases of syphilitic deafness. Carnevale Ricci⁴⁸ studied the ears of 43 patients with congenital syphilis and found marked changes in the ears characteristic of syphilis in 18 per cent. Syphilitic foci were found in all parts of the hearing organ in various degrees and stages of development. The author concludes that syphilitic involvement of the ear is more common in congenital syphilis than is generally appreciated.

Urechia⁴⁹ reports 2 cases of syphilitic labyrinthitis, in 1 of which the condition followed an injury to the skull. In the first, a man of 42 had acquired syphilis twenty years before and was treated only by a single series of injections. A heavy weight fell on his head, causing

47 König, R. Schädigung des Gehörorgans bei Diphtherie, Scharlach und Masern, *Ztschr. f. Hals-, Nasen- u. Ohrenh.* **43** 250-266, 1938.

48 Carnevale Ricci, F. Osservazione istopatologica sulla sifilide congenita dell'orecchio, *Arch. ital. di otol.* **50** 521-634 (Oct.) 1938.

49 Urechia, C. I. Paralyse generale traumatique et labyrinthite. Tabes conjugal et labyrinthite, *Paris med.* **2** 210-211 (Sept. 24) 1938.

unconsciousness for ten minutes. Five months later he complained of rheumatism in his legs and was found to have dementia paralytica with bilateral neurolabyrinthitis and slight deafness. Wassermann tests of both the blood and the spinal fluid were positive. The labyrinthine symptoms disappeared after antisyphilitic and malarial treatments but the defect in hearing remained. In the second case, a man of 55 had acquired syphilis twenty-two years before and was not treated. He complained of slight dizziness and loss of hearing. He was found to have tabes with bilateral deafness, Wassermann tests were negative for the blood but positive for the spinal fluid. The symptoms completely cleared up under malarial and antisyphilitic treatment. The author states that bilateral labyrinthitis with tabes is rare but might be seen more often if all tabetic patients were systematically investigated.

Ruskin and Hyslop⁵⁰ report a case of syphilitic deafness preceding the appearance of the chancre. A man of 40 was seen a few hours after a blow on the head because of pain in the right ear, headache, vertigo and nausea. The hearing in the right ear seemed diminished. Two weeks later the loss of hearing was greater, and a few weeks after this second examination a pimple on the glans penis was first noted. This was definitely diagnosed as a chancre. Four months later in spite of antisyphilitic treatment the right ear showed complete deafness. The authors base their diagnosis of syphilis antedating the chancre on the fact that when the patient was first seen the caloric test produced no reaction on the right side but the rotation test produced an equal response on each side.

[Comment. It is difficult to accept this as a case of syphilis of the inner ear preceding the chancre purely on the basis of paradoxical labyrinthine tests.]

Nerve Deafness from Allergy—The importance of allergy in the middle and the inner ear is suggested by Jones,⁵¹ who reports 3 cases. In a child of 7 known to be sensitive to chocolate, wheat and nuts earache and an injected drum membrane developed after the eating of nuts involving first one ear and then the other with both returning to normal two days later. A farmer complained of attacks of vertigo one or more times a week for a year and a half. Because he was a great drinker of milk he was placed on a milk-free diet and has remained free from attacks. A boy of 8 had almost continuous colds and attacks of otitis media, with malnutrition, constipation and diarrhea. He was placed on a diet excluding the common sources of allergy, namely, milk

⁵⁰ Ruskin, S. L., and Hyslop, G. H. Acute Syphilis of the Internal Ear. An Interesting Case Report, *Laryngoscope* 48:280-285 (April) 1938.

⁵¹ Jones, M. F. Manifestations of Allergy in the Ear. *Ann Otol Rhin & Laryng* 47:910-916 (Dec.) 1938.

eggs, chocolate, wheat and shell fish, and was placed in an environment free from the common allergenic inhalants. Improvement was rapid and steady.

[Comment. The author's reports are suggestive but not conclusive. To prove an allergic cause the symptoms must clear up on the removal of a substance and then be reproduced by adding the substance.]

Nerve Deafness from Miscellaneous Causes—Jerlang and Dederding⁵² made the surprising observation that of 28 patients submitted to intracranial section of the fifth nerve, 26 showed diminution in hearing several days after operation. There was marked impairment of perception for low tones, the upper limit being lowered in only 2 cases. The ear on the side not operated on was similarly involved, to a lesser degree. Tinnitus was present in 11, spontaneous nystagmus, in 20. Several months later the hearing was normal in some, improved in some and unchanged in some. The authors suggest vasomotor labyrinthine edema as a result of the sympathetic nerve connections between the carotid plexus, the middle ear and the gasserian ganglion, through the circle of Willis to the opposite side.

[Comment. The clinical observation is interesting but the explanation for it is rather involved.]

Yoshimura⁵³ studied 14 tumors of the cerebellopontile angle and concludes that dizziness is to be regarded as an early symptom in addition to perception deafness. The labyrinthine tests show diminution or absence of the response to rotatory, caloric or faradic stimulation. There may be spontaneous nystagmus of the first degree to both sides, which is slower and with a wider amplitude on looking toward the side of the tumor. There are vertical nystagmus on looking up and ataxia with deviation toward the side of the tumor. Involvement of the third, fifth, sixth and seventh nerves is observed. The roentgenogram shows a widening of the internal acoustic meatus with destruction of the pyramid.

Clark and Russell⁵⁴ describe the histologic findings in a patient with cortical deafness. A woman of 44 suffered a stroke with paralysis of the left arm and leg, from which a partial recovery was made. The hearing was normal. Two months after the initial attack a second stroke occurred. Examination revealed complete bilateral deafness with normal response to the caloric test in each ear and no definite signs of weakness.

⁵² Jerlang, E, and Dederding, D. Akustische und vestibulare Funktionsstörungen nach temporalen retro-ganglionären Trigemintomie, *Acta oto-laryng* **26** 625-631, 1938.

⁵³ Yoshimura, M. Beiträge zur Kenntnis der Gehörorganstörungen bei Kleinhirnbrückenwinkeltumoren, *Ausz. z. Otol.* (Tokyo) **32-36**, 1937, pp. 32-36.

⁵⁴ Clark, W. E. L., and Russell, W. R. Cortical Deafness Without Aphasia, *Brain* **61** 375-383 (Dec.) 1938.

of anesthesia, the previous hemiplegia having practically cleared up. There was no aphasia, and the patient was soon able to be up and around, complaining only that she could not feel the ground with her feet. The hearing did not return. Six months later death occurred from a pontile hemorrhage. Postmortem examination revealed an old hemorrhage into each external capsule cutting off the fibers to the upper portion of the temporal lobes of either side. The authors call attention to the fact that while a total of 18 cases of cortical deafness with post-mortem examination have been reported, this is the first time that deafness was present without aphasia.

[Comment. Because of the bilateral cortical representation of the auditory tracts from each ear a lesion of one temporal lobe does not result in loss of hearing, which has led some to doubt that the center for hearing is in the temporal lobes. The unique case reported by Clark and Russell is definite proof that the center of hearing is located in the upper portion of the temporal lobes on both sides.]

Doderlein⁵⁵ suggests logically that the better the function of an organ is the closer it is to normal and that true presbycusis can be studied only in old people with relatively good hearing. He accordingly studied the oldest people with the best hearing that he could find, a total of 50 between the ages of 80 and 94 being considered suitable. The lower tone limit was determined with difficulty and lay around 64 vibrations. The upper tone limit was easily obtained and lay around 4096 vibrations or a little higher. Between the ages of 20 and 50 the upper tone limit falls from 20,000 to 15,000 vibrations, and between 50 and 80 it falls from 15,000 to about 5,000 vibrations. The hearing for the voice also declines from perception at 15 meters at 20 to perception at 4 meters or less at 80, representing a loss of about three fourths of the hearing. If the loss of hearing is greater than this it must be regarded as pathologic. The histologic changes heretofore described for presbycusis have been based on ears of deafened people and, therefore, are to be regarded as pathologic rather than physiologic. To determine the histologic changes of presbycusis it will be necessary to study the ears of old people with perception of a whisper at up to 4 meters and an upper tone limit up to 5,000 vibrations. The author agrees with O. Mayer that changes will be found to occur in the elastic tissue of the basilar membrane similar to the loss of elasticity in the lens of the eye. Since perception for the highest tones is used least, the elasticity as it affects this is lost first.

Nussdorfer⁵⁶ studied audiometrically 300 patients between the ages of 20 and 70 and found a progressive lowering of the upper tone limit

⁵⁵ Doderlein, W. Ueber Presbycusis, Arch f. Ohren-, Nasen- u. Kehlkopfh. **144** 295 (April) 1938.

⁵⁶ Nussdorfer, R. Grafici audiometrici dell'orecchio senile, Atti clin. otolaring., Torino, 1938, pp. 437-453.

with a progressive elevation of the threshold over the entire tonal range and with relatively slight elevation of the lower tone limit. There was also abnormal fatigability of the senile ear for frequencies above 512 and a sudden dip to 4096 vibrations in a large proportion of cases.

Torrini⁵⁷ fed 6 guinea pigs a diet free from vitamin B and 6 a diet free from vitamin C, and after the animals had died as a result of the diet the inner ear was examined. The greatest changes were in the labyrinthine capsule, with early osteoporosis and with some halisteresis in those deprived of vitamin C. The organ of Corti showed no changes. The cells of the spinal ganglion showed degeneration with formation of vacuoles.

Kobrak⁵⁸ suggests that primary nerve deafness may result in a secondary reflex anomaly of the muscles of the middle ear, which in turn may further impair the function of the inner ear, thus resulting in a vicious circle. This, he suggests, would account for the undeniable benefit of inflation in many cases of inner ear deafness.

Treatment of Nerve Deafness—A few new treatments for nerve deafness were reported in 1938, none of them especially convincing or logical. Koch⁵⁹ reports the results of the treatment of the deafness of old age with various glandular preparations given by intramuscular injection. Of 19 patients treated, 7 complained of marked tinnitus without deafness and 6 were relieved. Twelve who were deafened each experienced improved hearing.

[Comment: There is no reason to expect that the purely degenerative and atrophic changes of presbycusis can be altered by any form of treatment. Results of this sort are of no value unless controlled by a parallel series of patients receiving no treatment.]

An experimental study of the effects of radiation on the ear was carried out on guinea pigs by Doi⁶⁰ with one or two needles of 5.5 mg of radium bromide placed for twenty-four hours to twenty-five days in the middle ear. It was found that continuous irradiation with small doses produced primary degeneration of all the endings in the labyrinth first in Corti's organ, then in the ganglion cells and lastly in the nerve fibers, with more damage in the cochlea than in the vestibular apparatus.

57 Torrini, G. Avitaminosi ed orecchio interno ricerche sperimentali, *Arch ital di otol* **50** 658-672 (Nov.) 1938.

58 Kobrak, F. Pathologische Physiologie und praktische Ohrenheilkunde. II. Die Mittelohrsuffizienz, eine funktionelle Miterkrankung des Mittelohrs, *Pract oto-rhino-laryng* **1** 293-300, 1938.

59 Koch, F. X. Die Hormonbehandlung der Altersschwerhörigkeit, *Monatschr f Ohrenh* **72** 777-790 (Aug.) 1938.

60 Doi, S. I. Experimentelle Studien über den Einfluss der Radiumbestrahlung auf den Gehörorgan, *Okayama-Igakkaï-Zasshi* **50** 1845-1846 (Sept.) 1938.

The greater the immediate dose with the same complete dose, the greater the degeneration of the labyrinth. No changes were found in the non-irradiated ear.

Further evidence that roentgen rays cannot have a beneficial effect on the ear directly is an article by Hays,⁶¹ who emphasizes that otosclerosis or nerve deafness cannot be affected by roentgen treatment. On the other hand, when the deafness is the result of occlusion of the eustachian tube by hypertrophy of lymphoid tissue in the nasopharynx or eustachian tube, roentgen treatment can be of benefit.

Kupfer⁶² theorizes that the Wever-Bray response is due to the solids and liquids in the cochlea acting as variable condensers and dielectric solutions. Movement of this fluid (by the footplate of the stapes) sets up electric currents. On the assumption that tinnitus and deafness may be due to electric currents in the diseased organ the author led into the ear electric currents from outside to neutralize these pathologic currents and improve the hearing. He claims good results in many cases.

[Comment: This is another bizarre form of treatment based on a nebulous theory.]

An even more fantastic type of treatment is advocated by Zajicek,⁶³ who reports on 40 patients with conditions such as inner ear deafness, presbycusis and adhesive middle ear deafness treated with "hormones" (not specified) plus the application of a "respiratory ferment ointment" (*Atmungsfermentsalben*) once a week behind the ear and over the adjacent part of the head and neck for four or five times. At the first application the patients declared that they could notice deep warmth, with a clearer feeling in the ear.

[Comment: Should scientific journals publish such manifestly unscientific material?]

Kanizsai⁶⁴ exposes the ears of deaf-mutes to loud sounds of from 25 to 1200 vibrations. As soon as there is a reaction, the sound is decreased until the threshold is reached. The purpose is to obtain a response from Corti's organ over as large a range as possible with the slightest possible stimulus. The author emphasizes the inestimable

61 Hays, H. The Truth About the X-Ray Treatment of Deafness, *Laryngoscope* **48** 176-182 (March) 1938.

62 Kupfer, E. On the Origin of the Wever-Bray Response and on an Electrotherapy of the Ear, *J. Laryng. & Otol.* **53** 16-31 (Jan.) 1938.

63 Zajicek, O. Die Hormonbehandlung der progressiven Schwerhörigkeit mit Atmungsfermentsalben als aussichtsreicher Weg, *Wien med. Wchnschr.* **88**, 213-215 (Feb. 19) 1938.

64 Kanizsai, D. Ueber mein heiltechnisches Verfahren bei der Gehorentwicklung bei Taubstummen und Personen mit Horresten, *Monatschr. f. Ohrenh.* **72** 277-287 (March) 1938.

psychologic significance of even small results in awakening the hearing of the tones for which perception remains

[Comment It is difficult to conceive of any benefits other than psychologic of this or of any other treatment of the hearing of deaf-mutes]

Ménière's Syndrome—The many interesting articles on Ménière's syndrome that appeared in 1938 included contributions on the pathology on the etiology and on the treatment of this dramatic disease

Hallpike and Cairns⁶⁵ contribute an important article on the pathology of Ménière's syndrome Except for a case of neurofibroma in the basal coil of the cochlea described by Wittmaack and a case of generalized encephalitis of traumatic origin described by Videbeck, there had been no histologic studies in cases of Ménière's syndrome, and the two previous reports were obviously of rare and unusual conditions and not of the ordinary attack of Ménière's syndrome It may, therefore, be said that this study of Hallpike and Cairns of 2 patients who died after section of the eighth nerve for relief of vertigo is the first histologic study of Ménière's disease to be reported

In the first case, a man of 63 complained of recurring attacks of vertigo for three years, increasing in severity until he lost his job For one year there had been progressive deafness in the left ear Hearing tests revealed diminished hearing in the left ear with shortened perception in the Schwabach test and a positive reaction to the Rinne test The caloric test showed no response from this ear but a prompt response from the right Death occurred three days after section of the eighth nerve, and autopsy was done six hours after death Both drum membranes were thickened, with bony thickening of the posterior edge of the left footplate of the stapes apparently of inflammatory origin The left saccule and scala media were grossly dilated, with obliteration of the perilymph spaces of the vestibule and scala vestibuli Corti's organ was degenerated on the left side The normal perisaccular connective tissue was absent on both sides The most striking change was the displacement of Reissner's membrane so that it lay flattened against the roof of the scala vestibuli with organizing connective tissue holding it in this position

In case 2 a man of 28 had increasing deafness in the left ear and vertigo for four years Hearing tests revealed defective hearing in the left ear, air conduction being better than bone conduction There was an equal response to caloric stimulus from both sides Death occurred the day after section of the eighth nerve, and autopsy was performed four hours later The left temporal bone only was examined histologi-

65 Hallpike, G. S., and Cairns, H. Observations on the Pathology of Ménière's Syndrome, *J. Laryng. & Otol.* **53** 625-655 (Oct.) 1938

cally. Again there was gross dilatation of the saccule and scala media, with obliteration of the perilymphatic cistern and the scala vestibuli. There was degeneration and rupture of the wall of the anterior vertical membranous canal with a dense albuminoid coagulum in its lumen. Corti's organ was degenerated, and the epithelium of the maculas and of the cristae of the canals was degenerated. The stria vascularis was degenerated. The normal area of perisaccular connective tissue around the saccus endolymphaticus was absent. Again the displacement of Reissner's membrane to the wall of the scala vestibuli was most striking.

In discussing these findings the authors point out that while the changes are consistent with serous labyrinthitis, the extreme and uniform dilatation of the endolymphatic system is extremely rare in serous labyrinthitis, nor can it be ascribed to the operation, since 5 patients who died after removal of acoustic tumors failed to show more than an insignificant displacement of Reissner's membrane. The authors suggest that in Ménière's syndrome there is increased endolymphatic pressure due to increased secretion or diminished absorption of endolymph. The bony spaces are finally filled by the increased endolymph until relatively slight increases in pressure result in anoxemia of the labyrinth and unopposed action of the opposite labyrinth. Finally, the authors suggest that diplacusis might occur because of stretching of the basilar membrane.

[Comment. The essential pathologic change, namely, extreme dilatation of the endolymph space must be regarded as the end result of the condition. These patients died between attacks, not during an attack. The pathologic picture during an attack remains to be described.]

An excellent description of Ménière's disease, based on a study of 117 patients seen during the past nine years, comes from Crowe⁶⁶. Of the total number the vestibular nerve was divided for 94, while therapy was not given to 23 with mild attacks. The disease was unilateral in 90 per cent, with marked impairment of hearing in the affected ear. The first symptom appeared between the ages of 30 and 60 in 80 per cent. Only 10 of 71 patients had a history of otitis media at any time, and only 5 had a history of allergy or migraine. A positive Wassermann reaction was obtained from only 2.

The vestibular responses (minimal caloric reaction) were normal in 35 per cent, subnormal in 19 per cent and absent in 29 per cent, while in 17 per cent the tests were not made. Some patients with no caloric response in the affected ear had vertigo and were relieved by section of the vestibular nerve. The vestibular tests, therefore, have no value in the diagnosis and prognosis of Ménière's disease.

The deafness was of the inner ear type. It was usually progressive but had the peculiar characteristic of fluctuating. In this respect the

⁶⁶ Crowe, S. J. Ménière's Disease, *Medicine* **17** 1-36 (Feb.) 1938.

deafness differs from inner ear deafness due to all other causes. The tinnitus likewise fluctuates.

The vertigo occurs characteristically in attacks, with periods of complete freedom from dizziness between attacks. However, in some cases there is constant dizziness, punctuated by sudden severe attacks of vertigo. Spontaneous remissions are frequent and vary from a few months to twelve years. Because of these remissions one must be cautious about judging the effects of therapy.

The diagnosis of Ménière's disease is made by the history of attacks of vertigo. Deafness and tinnitus are usually, but not necessarily, present and may precede the onset of vertigo. Loss of consciousness may occur during the attacks of dizziness but never with convulsions.

The treatment of Meniere's disease is section of the vestibular portion of the eighth nerve and always results in cure of the vertigo. When the deafness is bilateral one vestibular nerve is cut, and if the vertigo persists, the other nerve is cut. Of 72 cases the hearing after operation was worse in 22, unchanged in 36 and improved in 14.

The cause for Meniere's disease is unknown. The author believes, however, that it lies in the labyrinth and may be a disturbance of the chemical composition or pressure of the endolymph.

[Comment. This authoritative description of Meniere's disease is based on an unusually large number of cases. Many will disagree with the author's statement that surgical section of the vestibular nerve is the only treatment. In my own experience, allergy or focal infection accounts for the condition in most cases, and removal of the food or foods to which the patient is allergic results in complete and immediate relief from the vertigo and tinnitus and usually in improvement in the hearing. Cutaneous tests are of only occasional value, since they are negative in many cases. One must employ an elimination diet, eliminating wheat, milk, eggs, chocolate, coffee, citrus fruits and other common causes of food allergy, and then add these foods one by one until the offending substance is discovered.]

The fluctuating nature of the deafness in Meniere's disease, brought out by Crowe, is confirmed by my own observations. In addition, the patients all, or nearly all, show diplacusis.]

Mygind and Dederding⁶⁷ continue their writing on Ménière's disease as a manifestation in the ear of disturbed water metabolism. They

67 Mygind, S. H., and Dederding, D. Meniere's Disease as an Indication of Disturbances in Water Metabolism, Capillary Function and Body Condition, *Ann Otol, Rhin & Laryng* **47** 55-62 (March) 1938, Clinical Experiments with Reference to the Influence of the Water Metabolism on the Ear, *ibid* **47** 360-369 (June) 1938, The Diagnosis and Treatment of Meniere's Disease, *ibid* **47** 768-774 (Sept.) 1938, The Pathogenesis of Meniere's Disease and of Kindred Conditions in the Ear and the Rest of the Body, *ibid* **47** 938-946 (Dec.) 1938, The Problems of Aural Medicine, *J Laryng & Otol* **53** 35-46 (Jan.) 1938.

define Ménière's disease as an aural disease with periodically varying acoustic and vestibular symptoms which do not present any special cause (such as symptoms referable to the middle ear, syphilis, tumor of the brain and trauma) The hearing is nearly always reduced, the tests always revealing a disturbance of the sound-conducting mechanism with elevation of the lower tone limit as well as loss of perception for upper tones by air conduction (but not by bone conduction) The bone conduction for a-1 (435 vibrations) may be shortened, but this is consistent with disturbance of the sound-conducting mechanism rather than perception deafness as previously believed

[Comment I cannot agree with these authors that shortened bone conduction is consistent with conduction deafness and that the patients have conduction rather than perception deafness True, they show a loss of perception for low tones as well as for high, but, as I have pointed out, this is low tone perception deafness and not conduction deafness]

The most characteristic feature of the hearing is its fluctuation, with changes from day to day or even from hour to hour The tinnitus also is variable in intensity and is not always present Autophony and diplacusis are not rare

Spontaneous nystagmus is always present at some time, and the oftener the patient is examined the more frequently it will be seen The direction of the nystagmus can be toward or away from the affected ear The vertigo occurs in all forms and degrees

In addition to the aural symptoms, certain general symptoms are common in such patients Headache is the most frequent and may be in the form of migraine Subcutaneous nonpitting edema is frequent Vasomotor rhinitis, gastrointestinal disturbances and rheumatism are other frequent symptoms Variations in the quantity and weight of urine are not uncommon, retention of water often preceding an attack of vertigo

Perspiration from physical exercise may give relief from the dizziness, while the ingestion of much fluid does not agree with the patients A good many have of their own accord reduced their consumption of liquid and salt

Clinical experiments on water metabolism in Ménière's disease were carried out by the authors Mersalyl, a powerful diuretic, was injected intravenously (1 cc of a 10 per cent solution) seventy-seven times for 46 patients, and in 33 a definite improvement in hearing resulted, usually toward the end of the diuresis The lower tone limit improved as much as from 150 to 55 vibrations, and perception of the whispered voice from at the ear to 20 meters The opposite experiment was carried out, and 1,000 cc of water was administered to the fasting patient before breakfast A great number of patients with Ménière's disease showed more

or less pronounced reduction in hearing during the following four hours, with elevation of the lower tone limit and shortening of air and bone conduction for a-1 (435 vibrations), as well as impairment of perception for the whisper. The results were the same as those obtained by Fürstenberg. The beneficial effect of the Fürstenberg diet is due, the authors believe, to the fact that it is dehydrating, since it is poor in salt, rather than to its restriction of the intake of sodium.

In the treatment of Ménière's disease the other conditions that may produce the same symptoms must first be ruled out, namely, suppuration of the middle ear, tubal catarrh and stenosis, syphilitic neurolabyrinthitis, otosclerosis, epidemic encephalitis, disseminated sclerosis, cerebral tumor and tumor of the acoustic nerve.

The treatment of an acute attack of Ménière's disease consists of rest in bed in a dark room with a minimum of medication. For severe attacks 0.5 mg. of atropine given subcutaneously has seemed to be of benefit. Aside from reducing the intake of fluid and salt, nothing more is done for the acute attack. Before beginning even this treatment it is helpful to have the patient record all that he eats and drinks for three or four days of his usual diet. He is then submitted to the water retention test. Before breakfast he is weighed and empties his bladder. He then drinks 1,000 cc. of water, and after four hours he is weighed and his total diuresis is measured. If he retains 250 to 300 cc., his intake of fluid, including drink, vegetables and fruit is limited to 600 cc. If the retention of water is greater, the intake of fluid may be limited to 500 cc. or even 400 cc., while if there is no retention he is allowed 800 cc. of liquid. Food may be prepared as usual, but he is not allowed to add any salt, and salty foods are avoided.

Besides the diet, ultraviolet light baths are given to increase the cutaneous circulation, and baths, massage and exercise may be used to improve the vasomotor tone. Daily catheterization of the eustachian tube prevents stenosis, mobilizes the ossicles and influences the content of the labyrinth via the fenestrae. It is desirable to hospitalize the patient during the first month in order to acquaint him thoroughly with his disease, to provide sufficient rest and quiet and to regulate his regimen strictly. After three to six months of the regimen at home most patients may resume an ordinary mode of living, but subject to recurrences after infections, overexertion, pregnancy and the menopause. As a rule, the dizziness will be cured, or at least reduced to a minimum. Of those followed for three years or more 81 per cent remained permanently free from vertigo. The hearing was distinctly improved on dismissal from the hospital in more than half and about half of those (one fourth of the total) maintained their improvement. In isolated cases the condition defies all treatment.

As a result of their observations, the authors conclude that in Ménière's disease there is disturbance of water metabolism, not only in the ear but also in other parts of the body. The periodic fluctuation of this disturbance is due to vasomotor dysfunction. Water is deposited in the labyrinth, eustachian tube, brain, nasal mucosa, gastrointestinal mucosa, muscles or subcutaneous tissues, according to the local disturbances in vasomotor reflexes. These accumulations of fluid are intracellular rather than intercellular, as evidenced by the failure of the subcutaneous edema to pit on pressure. As the process continues, the edema gradually changes into atrophic and fibrous alterations.

The retention of water in the labyrinth results in increased endolymphatic pressure and causes low tone deafness by fixation of the stapes from the inside. The diminished bone conduction in this conduction deafness is due to outward dislocation of the footplate of the stapes resulting in decreased contact between the stapes and the oval window. The vestibular symptoms are due to the intracellular pressure of the edematous sensory cells exceeding the endolymphatic pressure, or vice versa. The apoplectic attacks are possibly due to sudden jerky yielding of the footplate of the stapes to the fluctuating endolymphatic pressure. Finally, the authors assert that there is no sharp boundary between typical Ménière's disease and common catarrh of the middle ear with tubal stenosis and neurolabyrinthitis.

[Comment. The authors' observations are interesting. It is remarkable that they have not thought of allergy as an explanation for the various edemas observed. A food allergy will explain better than anything else all the observations made by these authors.]

Quix,⁶⁸ in discussing the etiology of Ménière's disease, suggests that the fact that the vestibular apparatus usually recovers following the attack while the hearing does not is best explained by the fact that the attack occurs in the labyrinth and the cells of Corti's organ are nourished by the endolymph and are, therefore, more susceptible to endolymphatic changes, whereas the cells of the cristae and maculas are supplied by their own blood vessels. The author, however, is not sure but that Ménière's disease may be central rather than peripheral because of the headache, nausea and changes in corneal sensitivity on the same side.

Granstrom and Nylén⁶⁹ describe the case of a woman of 56 who for a number of years had suffered from attacks of vertigo and of iritis with

⁶⁸ Quix, F. H. La maladie de Ménière, *Ann. d'oto-laryng.*, July 1938, pp. 596-604.

⁶⁹ Granstrom, K. O., and Nylén, C. O. Causes de vertige de Ménière et crises d'iritis avec oedème de Quincke dans les paupières chez une même patiente, *Acta oto-laryng.* 26: 717-725, 1938.

palpebral Quincke edema. They suggest that an allergic disorder was responsible for her symptoms, although it was impossible to determine the etiologic factor, the cutaneous tests all being negative.

[Comment: The authors made the common mistake of relying on cutaneous tests to determine food allergy. Since in many cases of food allergy, perhaps in the majority, the cutaneous tests are negative, one must use the elimination method for diagnosis.]

Alfoldy⁷⁰ refers to the symptom complex of Ménière as "eighth nerve crises." He points out that the attacks are related to vasomotor rhinitis, asthma, Quincke's edema, mucous colitis and migraine. Nonspecific histamine therapy is used, at first intracutaneously to lessen the shock and observe the local reaction, and then subcutaneously in increasing doses every second day. In general, ten to twenty injections result in complete recovery.

[Comment: The allergic factor in Ménière's disease is again suggested by this contribution.]

Guttich⁷¹ describes 2 cases of Ménière's syndrome following intense exposure to sunshine. In 1 there was a marked inner ear defect in hearing, and in both positional nystagmus was present. The symptoms had completely disappeared the next day in 1, but in the other the nystagmus lasted three weeks and permanent nerve deafness in one ear remained. The author suggests histamine poisoning of the central vestibular nuclei.

[Comment: The deafness indicates a peripheral rather than a central disturbance.]

Bram⁷² calls attention to the fact that dizziness is a frequent symptom of anxiety neurosis and is usually associated with severe feelings of anxiety and symptoms of overactivity of the sympathetic nervous system. Vertigo is not unknown in petit mal, in migraine and with localized cortical lesions and may, in fact, occur with a tumor of the brain in any location. Vertigo may be produced by paralysis of the ocular muscle with diplopia. Cerebellar lesions may, but do not always, cause vertigo. Lesions of the brain stem, particularly disseminated sclerosis, cause vertigo, usually without deafness and tinnitus and with weakness of the oculomotor or facial nerve or other evidence of disseminated sclerosis. Finally, lesions of the eighth nerve, such as a tumor or an anomalous vessel, may cause vertigo.

70 Alfoldy, E. Le traitement des "crises octavus" angioneurotiques selon les principes les plus modernes, *Ann d'oto-laryng*, December 1938, pp 1159-1163.

71 Guttich, A. Ueber Menieresche Symptome nach Insolation, *Arch f Ohren-, Nasen- u Kehlkopfh* **145** 499-500, 1938.

72 Bram, W. R. Vertigo. Its Neurological, Otological, Circulatory and Surgical Aspects, *Brit M J* **2** 605-608 (Sept 17) 1938.

Aural vertigo may be the result of acute labyrinthitis secondary to suppurative otitis media. More often it is part of Ménière's syndrome. This syndrome is characterized by the sudden onset in a previously healthy auditory apparatus of tinnitus, deafness and vertigo with ataxia, nausea, vomiting and fainting. The deafness is progressive, and there may be transitory loss of vision or diplopia during the attacks.

The age at occurrence averages 49. The most important etiologic factor is focal infection, the imbalance of water emphasized by Mygind, Dedeiding and Furstenberg being probably a contributory factor but not the main cause. Treatment consists of the eradication of any source of infection. Tobacco may be the cause in susceptible persons. Restriction of fluid may be helpful. Phenobarbital, $\frac{1}{2}$ grain (0.03 Gm.) two or three times a day, is valuable. Surgical intervention is indicated only for the rare resistant condition.

Wright⁷³ emphasizes the role of focal infection in Ménière's syndrome. He states that labyrinthine vertigo may be recognized by the coincidence of tinnitus and deafness, though, rarely, these may be absent in the early stages. In addition, certain tones may be heard at a higher or lower pitch in the affected than in the normal ear, and the sounds may be actually painful.

[Comment: Since testing routinely for diplacusis I have found this symptom invariably present in Ménière's disease.]

The following conditions can cause labyrinthine vertigo: localized or diffuse suppurative labyrinthitis secondary to suppurative otitis media, mumps (usually unilateral), herpes of the geniculate ganglion, congenital syphilis resulting in a completely deaf ear, usually bilateral, acquired syphilis, usually in the late secondary stage with acute labyrinthine involvement resulting in complete destruction of the labyrinth in two or three weeks, fracture through the base of the skull and labyrinth, quinine, salicylates and tobacco, and focal labyrinthitis (Ménière's disease).

In the author's series of 70 cases of Ménière's disease or, as he prefers to call it, focal labyrinthitis, the average age was 47. In no case, on critical examination, was a pathologic change in the eustachian tube found. A focus of infection can be found in every case.

[Comment: Because tonsils are removed only exceptionally in England and because dental hygiene in England, as a rule, is poorer than in this country foci may be found more often there than in the United States. Certainly many patients with Ménière's disease seen in this country have no obvious foci of infection.]

⁷³ Wright, A. J. Aural Vertigo, *J. Laryng. & Otol.* **53** 97-112 (Feb.) 1938, Labyrinthine Giddiness. Its Nature and Treatment, *Brit. M. J.* **1** 668-670 (March 26) 1938.

In 23 of the author's cases all foci were removed. In 10 the vertigo and tinnitus ceased and the hearing returned to normal. In 3 the vertigo ceased and the hearing improved, while in 8 the vertigo ceased but the deafness persisted. In 2 cases one focus was removed without improvement but other foci (teeth or tonsils) remained and are probably responsible. On the other hand, the author has observed no case of spontaneous cure with restoration of normal hearing, although the frequent long periods of freedom from vertigo make it difficult to evaluate the results of treatment.

The author believes that the condition in his 70 cases is a definite disease, consisting of a primary lesion of the labyrinth not resulting from a lesion of the middle ear. The clinical course is similar to that in chronic iritis with the difference that in iritis one can visualize the lesion and see that it is inflammatory.

[Comment. The similarity between iritis and certain cases of Meniere's disease has been pointed out by me also.]

Mackenzie⁷⁴ uses the term "neurolabyrinthitis" to designate any inflammation involving the eighth nerve and labyrinth which may be caused by syphilis, acute infectious fevers, chronic infections, poisons, exposure to cold or focal infection.

Syphilis affects the ear in four ways. 1. In acquired syphilis there is bilateral neurolabyrinthitis with perceptive deafness, vertigo, nystagmus at first toward and later away from the affected ear, hyperirritability of the labyrinth at first and later hypoirritability, strongly positive Wassermann reactions and other evidences of syphilis, diminished galvanic response and a favorable response to antisyphilitic treatment. 2. In congenital syphilis the onset is sudden and bilateral, with profound perception deafness, rotary vertigo and spontaneous nystagmus with early hyperirritability and late hypoirritability to the caloric test but normal galvanic response, mildly positive Wassermann reactions, other signs of congenital syphilis (teeth and eyes) and unfavorable response to treatment. 3. In gummatous infiltration of the floor of the skull and the temporal bone there are unilateral gradual perceptive deafness, vertigo and nystagmus, early hyperirritability and late hypoirritability to the caloric tests, strongly positive Wassermann reactions, involvement of the seventh, ninth or other cranial nerve and favorable response to early and intensive treatment with iodides. 4. In primary retiolabyrinthine atrophy from metasymphylis there is bilateral progressive perceptive deafness with only occasional mild vertigo and nystagmus, diminished caloric and galvanic response, frequent involvement of the posterior column of the spinal cord and mildly positive Wassermann reactions.

⁷⁴ Mackenzie, G. W. Neurolabyrinthitis, *Internat. Clin.* 2:126-134 (June) 1938.

Neuritis of the eighth nerve from acute infectious fever, especially mumps and meningococcic meningitis, is typically bilateral [a misstatement by the author, since deafness from mumps is typically unilateral], while neuritis from chronic infections (tuberculosis, leukemia and leprosy) and from poisons (snake venom, alcohol, salicylates, quinine, arsenic, mercury and lead) is usually bilateral.

Labyrinthitis from focal infection is by far the most frequent cause for Ménière's syndrome. There is practically always an attack of influenza some weeks or months before the onset. An abscessed tooth has been the most frequent focus in the author's experience. After removal of a focus the symptoms are relieved and the hearing is improved.

Leichsenring⁷⁵ treats acute attacks of Ménière's disease by prescribing a fast of several hours and then giving $\frac{1}{2}$ to $\frac{3}{4}$ liter of linden blossom tea followed by hot packs and the injection of 0.01 to 0.02 of pilocarpine. After two hours the patient is rubbed down with French brandy and the bed is changed. If necessary the dose of pilocarpine is increased the following day. The treatment continues for several days. Concerning results, the author states that "the results of this treatment are so good that I am inclined to doubt the correctness of the diagnosis rather than the effectiveness of the treatment when it fails."

[Comment: Since the usual attack of Ménière's disease is self limited and rarely lasts more than a few hours, it seems doubtful that the improvement observed by the author is the result of his treatment.]

Surgical treatment of Ménière's syndrome by section of the vestibular nerve is recommended by Olivecrona,⁷⁶ who has observed unsatisfactory results from medical treatment. Of 21 patients operated on, all but 1 have remained free from attacks of vertigo. By sparing the cochlear nerve the hearing after operation is preserved unchanged and the danger of injuring the facial nerve and the operative risk are rendered slight.

Aubry and Ombredanne⁷⁷ employ the intracranial section of the eighth nerve only for marked vertigo which resists other therapeutic attempts. Of 9 patients operated on, 7 experienced relief from their vertigo.

Simonetta⁷⁸ reports 2 cases of Ménière's syndrome in which he intended to section the nerve but encountered cystic arachnoiditis of

⁷⁵ Leichsenring, E. Die Behandlung der Ménièreschen Krankheit mit der Pilocarpin Schwitzkur, *Med. Klin.* **34** 1361 (Oct. 14) 1938.

⁷⁶ Olivecrona, H. Ueber Ménière's Krankheit und ihre chirurgische Behandlung, *Schweiz. med. Wchnschr.* **68**:125-128 (Feb. 5) 1938.

⁷⁷ Aubry, M., and Ombredanne, M. Indications et résultats de la chirurgie intracrânienne du nerf auditif, *Ann. d'oto-laryng.*, October 1938, pp. 999-1003.

⁷⁸ Simonetta, B. Sulle indicazioni della resezione della branca vestibolare dell'acustico nella vertigine de Menière, *Riv. oto-neuro-oftal.* **15** 401-407 (Sept-Oct.) 1938.

the posterior fossa and the patient was cured without section of the nerve. He therefore believes that the nerve should be cut only when no changes of the arachnoid can be demonstrated.

Smith and White⁷⁹ report the unusual combination in the same patient of tic douloureux and Ménière's syndrome, the patient having experienced her first and only attack of vertigo two weeks before the fifth and the vestibular portion of the eighth nerve were divided at a single operation with complete and immediate relief of all symptoms.

Putnam⁸⁰ describes a new method of surgically treating Ménière's syndrome. A man of 44 with recurrent vertigo was operated on, the intention being to section the eighth nerve. Because of technical difficulties the operation was terminated before the nerve could be exposed. The symptoms continued. At a second operation the dura was elevated over the arcuate eminence through a subtemporal decompression and a burr was used to enter the superior canal. A fine wire was introduced into the canal anteriorly and a light cutting current applied for five seconds. There was no further dizziness, but because the tinnitus persisted the original hole was enlarged, with exposure of the utricle and coagulation for a longer period. Even this failed to destroy all the hearing, so the cochlea was exposed through the same approach and lightly cauterized. The hearing was finally destroyed, but paralysis of the facial nerve lasting six weeks occurred, and the tinnitus persisted. The patient occasionally feels slightly dizzy.

A second patient, a woman of 43 with recurring vertigo following acute otitis media unrelieved by the Furstenberg regimen, was also operated on through subtemporal decompression with opening and coagulation of the superior canal for fifteen seconds. A month later there was a severe attack of vertigo, so the opposite superior canal was operated on in a similar manner. Following this there were severe attacks of vertigo and hearing tests showed partial but not complete deafness in this second, previously well hearing, ear. The tinnitus was unchanged.

The author concludes that in 2 cases "the severe attacks of vertigo have been done away with by a simple, safe operation, which need not affect hearing."

[Comment: The author's enthusiasm for this procedure hardly seems justified by his case reports.]

79 Smith, H. M., and White, M. Concurrent Tic Douloureux and Ménière's Disease Treated Surgically, *J. A. M. A.* **111** 782-783 (Aug. 27) 1938.

80 Putnam, T. J. Treatment of Recurrent Vertigo (Ménière's Syndrome) by Subtemporal Destruction of the Labyrinth, *Arch. Otolaryng.* **27** 161-168 (Feb) 1938.

Peacock⁸¹ injected alcohol through the drum membrane and oval window in 2 patients with aural vertigo, using a needle with a double lumen, so that the labyrinth was rinsed out. After initial symptoms of vertigo, function was completely abolished.

Wright⁸² first destroyed the labyrinth by alcohol injected through the oval window in 1935, but permanent paralysis of the facial nerve resulted from the excessive amount of alcohol used. Since then he has reduced the amount of alcohol to 1 minim (0.06 cc) and in only 1 case has he had temporary paralysis of the facial nerve. This procedure is indicated only for the exceptional patient since removal of foci will cure the majority. When the age of the patient precludes removal of foci or when the vertigo results from suppuration of the middle ear, especially after the radical operation, the procedure is simpler, safer and quicker than section of the eighth nerve.

The author uses an electric otoscope, a special spring-operated syringe with a special trigger release and an angled needle, the point of which is beveled nearly flat. The meatus is cleaned before the operation, but at the operation no preparation is given to the meatus. Absolute alcohol colored with methylthionine chloride (methylene blue) is used for the injection. Light general anesthesia is employed. The oval window lies on a line drawn through the short process of the malleus at an angle of 15 degrees above a line joining the external meatus and the infra-orbital ridge, the latter line being marked by a thin strip of adhesive tape. The needle is inserted at the approximate position of the oval window, and firm pressure is made in one or more positions until the needle is felt to pass through a thin layer of bone and inward 2 mm. This should be practiced first on the cadaver. In the 1 case of temporary paralysis of the facial nerve the needle evidently entered the facial canal instead of the labyrinth, since a sudden contraction of the facial muscles occurred without destruction of the labyrinth. A week later the operation was successfully repeated.

Following the operation there are vomiting and vertigo lasting a few days, the patient being out of bed by the fourth or fifth day. There have been no infections.

Yearsley⁸³ reports 5 cases in which labyrinthectomy was performed between 1908 and 1933 for vertigo. In all 5 cases otitis media had occurred previously. In each case radical mastoidectomy was followed

81 Peacock, R. Alcoholic Labyrinthine Injection Through the Oval Window in the Treatment of Aural Vertigo, *Lancet* **1** 421-423 (Feb. 19) 1938.

82 Wright, A. J. Labyrinthine Destruction in the Treatment of Vertigo by the Injection of Alcohol Through the Oval Window, *J. Laryng. & Otol.* **53** 594-597 (Sept.) 1938.

83 Yearsley, M. Operative Treatment of Labyrinthine Vertigo, *Lancet* **2** 618-619 (Sept. 10) 1938.

by labyrinthectomy. The author believes that this procedure is simpler and safer than intracranial section of the eighth nerve.

[Comment. In summarizing these interesting contributions on the treatment of Ménière's disease or syndrome—the two terms are applied by different authors to the same condition, and there is some question in my mind which is preferable—there is considerable evidence that focal infection plays a part in at least some cases, that allergy is a factor in others and that there may be a few remaining instances in which surgical treatment is required. Sectioning the vestibular nerve has the advantage of frequently preserving the hearing, but it is a major surgical procedure not without risk. Injection of alcohol through the oval window is a simple procedure, which, however, sacrifices what hearing remains and which may injure the facial nerve. Labyrinthectomy or the subtemporal approach described by Putnam seems to be a more extensive operation than injection through the oval window, with no advantages.]

122 South Michigan Avenue

News and Comment

INTERNATIONAL COLLEGE OF SURGEONS

The officers of the United States chapter of the International College of Surgeons cordially invite all physicians and surgeons in good standing to their fourth annual assembly, to be held in Venice, Fla., Feb 11 to 14, 1940. There is no registration fee.

The convention will be under the direction of Dr. Fred H. Albee, of New York, international president-elect, and Dr. Frederick M. Douglass, of Toledo, Ohio, president of the United States chapter.

For general information please address Dr. Fred H. Albee, chairman, 57 West Fifty-Seventh Street, New York. For information about the presentation of scientific papers or exhibits, address Dr. Charles H. Arnold, secretary of the scientific assembly, Terminal Building, Lincoln, Neb.

Abstracts from Current Literature

Ear

EAR COMPLICATIONS OF SCARLET FEVER A L HOVNE and R SPAETH, J Pediat
12 287 (March) 1938

The aural complications of scarlet fever are so frequent and so serious that their importance should be appreciated more fully by members of the medical profession. A study was made of the aural complications among 3,564 patients with scarlet fever treated at the Municipal Contagious Disease Hospital in Chicago from July 1, 1934, to June 30, 1935. Tables are presented showing the data on the incidence of otitis media among these patients in comparison with similar data taken from the literature. The incidence of mastoiditis, the number of mastoidectomies done, the mortality, and the complications of mastoid disease in the 3,564 cases also are given in tabular form. Other tables included in the report show the week of onset of purulent otitis media, the incidence according to age and the importance of this complication as a cause of death.

The authors suggest certain therapeutic measures which would in all probability have a distinct influence on the incidence of otitis media. General supportive measures, such as blood transfusions, parenteral administration of fluids, adequate diet and effective sedative therapy, appear to increase the patient's resistance to infections of the middle ear and mastoid. Maintenance of unobstructed nasal passages is essential to the prevention of the mechanical spread of septic material from the nasopharynx through the eustachian tubes to the middle ear. Irrigations of the throat and gargles are to be avoided. In hospital wards patients with uncomplicated scarlet fever should be separated from those with complications, and protection from cross infections is essential. Care must be taken to resort to paracentesis only when necessary, and the operation should be done by an otologist or a competent physician. Irrigations of draining ears have not been done at the Municipal Contagious Disease Hospital during the past eighteen years, but recent reports in the literature on the beneficial action of irrigation with alcohol have been encouraging, and the procedure may be useful. A strict aseptic technic is essential in the care of the draining ear. It is suggested that adenoidectomy be done on patients with otorrhea, in order to decrease the duration of the aural discharge and avoid incriminating invasion of the mastoid cells as a cause of prolonged aural discharge.

RAUH, Cincinnati [AM J Dis Child]

PARA-AMINOBENZENESULFONAMIDE AND ITS DERIVATIVES IN THE TREATMENT OF BETA HEMOLYTIC STREPTOCOCCUS INFECTIONS OF THE MIDDLE EAR AND MASTOID. REPORT OF SIX CASES IN CHILDREN. C G FLAKE and B W CAREY JR, New England J Med **217** 1033 (Dec 23) 1937

Flake and Carey studied the effects of sulfanilamide therapy in 3 patients with meningitis, 1 patient with sterile meningitis, 1 patient with a perisinal abscess and septicemia and 1 patient with postscarlatinal mastoiditis. All the patients recovered. The cases are reported in detail.

In cases 1 and 2 administration of the drug was started subcutaneously and intrathecally. Sulfanilamide was given orally as soon as the condition of the patient permitted. In case 3 subcutaneous or intrathecal treatment with sulfanilamide was not given until twenty-four hours after beta hemolytic streptococci were discovered in the cerebrospinal fluid, but sulfanilamide was given orally in adequate doses during this period.

In case 4 there had been bilateral mastoidectomy and adenoidectomy. Three days after operation meningitic symptoms occurred. The spinal fluid contained

2,800 leukocytes per cubic millimeter (65 per cent polymorphonuclear cells), but smears and cultures were negative. The treatment included administration of sulfanilamide and neoprontosil and blood transfusion.

Case 5 is presented to demonstrate the marked fall in temperature, rapid sterilization of the blood stream and general improvement in a child gravely ill with acute mastoiditis, perisinal abscess and septicemia after simple mastoidectomy with exposure of the lateral sinus and institution of therapy with sulfanilamide and its derivatives.

In case 6 sulfanilamide was given before and after operation.

GENGENBACH, Denver [AM J DIS CHILD]

SULPHONAMIDE IN THE TREATMENT OF ACUTE MASTOIDITIS V G HORAN and S G FRENCH, Brit M J 2 942 (Nov 5) 1938

These observations were made at the Royal Naval Hospital, Chatham, England, and presumably were made on adults. However, the work probably applies equally to children, although this is not definitely determined. The authors point out that there is a seasonal variation in mastoid complications of middle ear disease. The surgeon of today is apt to adopt an expectant line of treatment rather than the radical one. It is important that administration of sulfanilamide be practiced early rather than late. On account of this practice it may be that an error in estimating results arises in that many who were expected to have mastoid involvement might not have reached that stage in any event. The argument and statement of experience are conservative. In spite of the possible sources of error in the figures published in the report, the conclusions are that the incidence of acute mastoiditis in the Royal Naval Hospital, Chatham, has been notably reduced and that, since the only difference in the treatment of acute disease of the ear has been the introduction of routine administration of sulfanilamide on admission, it is reasonable to suppose that the aforementioned drop in the incidence of mastoiditis is due to the use of the drug. Therefore sulfanilamide and the related drugs have a real place in the treatment of acute suppurative otitis media.

ROYSTER, University, Va [AM J DIS CHILD]

PROGRESSIVE FACIAL PALSY PRODUCED BY INTRATEMPORAL EPIDERMoids G JEFFERSON and A A SMALLEY, J Laryng & Otol 53 417 (July) 1938

During the last five years Jefferson and Smalley encountered 6 patients in each of whom slowly progressive palsy of the facial nerve was proved to be due to an epidermoid lodged within the temporal bone. No infection was present in any of them, and 3 patients had never had otitis media. All, however, were deaf to a greater or less degree on the side of the palsy, and this fact led to a painstaking investigation of the temporal bone for a possible causative lesion. The paralysis of the facial nerve had in each case taken several months to develop and was in that respect totally unlike Bell's palsy. The syndrome is related to the pure pressure effect of an epidermoid and not to any septic condition such as accompanies the ordinary cholesteatoma.

J A M A

FLUID BALANCE IN MÉNIÈRE'S DISEASE T CAWTHORNE and MARY N FAWCETT, Lancet 2 1404 (Dec 17) 1938

Cawthorne and Fawcett studied the effect of various intakes of salt and fluid on the symptoms of Ménière's disease in 11 patients. All but 1 were affected to a greater or less degree by variations in the intake of fluid and sodium chloride. Any steps taken to favor the retention of fluid within the body resulted in aggravation of the symptoms, whereas the reverse was true when excretion of fluid was encouraged. In 9 cases this fluctuation of the symptoms was accompanied by variation in the hearing capacity, thus, when the symptoms were more marked the hearing was worse, and vice versa. None of the patients under

review tended to retain fluid unduly, although they were all sensitive to variations in the salt and fluid intake. It seems that imperfect functioning of the pressure-regulating mechanism of the endolymphatic system places the affected labyrinth under the influence of any factors that may affect the secretion or absorption of endolymph on that side. It is not unreasonable to suppose that an increase of the fluid content of the body may favor an increase of the intralabyrinthine pressure. It is recommended that an antiretentional regimen should form part of the investigation of every patient with Meniere's disease.

J A M A

A REVIEW OF THE PROBLEMS OF SUPPURATIVE PETROSITIS AND OF ITS SURGICAL TREATMENT, TOGETHER WITH AN OUTLINE OF THE PROPHYLAXIS AND TREATMENT OF OTITIC MENINGITIS. D G CARRUTHERS, M J Australia 2 644 (Oct 15) 1938

Carruthers feels that inasmuch as a high percentage of patients who die of otitic meningitis are found at autopsy to have suppurative foci in the petrous pyramid with evidence of direct extension to the meninges, the physician must always consider the possibility of such foci in any case of suppuration of the middle ear in which recovery is not taking place. Petrositis is a comparatively late complication of acute otitis media and may become manifest even after mastoidectomy. The first symptom is pain or aching in the orbit, face, forehead or parietal region on the affected side. Latency is not uncommon when pus first escapes into the meninges. The second symptom is a profuse or moderately profuse purulent discharge, especially one that persists or returns after the mastoid cells have been everted. The third symptom, paralysis of the sixth nerve (Gradenigo's syndrome), is not as common as was formerly taught. Low grade pyrexia is common. Transient facial weakness, slight vertigo and nystagmus may be present. Careful and repeated roentgenographic examination may be of great diagnostic help. In interpreting typical signs and symptoms one may have to exclude sphenoid sinusitis, thrombosis of the superior petrosal or cavernous sinus and labyrinthitis. The operative technic developed by Kopetzky and Almour and Lempert is described. In treating the various deep-seated complications of otitis media the surgeon must always watch for signs of early meningitis—any increase in the number of cells in the cerebrospinal fluid and any disturbance in the normal relation of the lactic acid, carbon dioxide, hydrogen ion concentration and chloride content of the blood and cerebrospinal fluid. Once meningitis has occurred, treatment consists in (1) surgical drainage of the feeding focus in the temporal bone, (2) administration of specific antiserum, (3) transfusion of a small amount of whole blood every one or two days and (4) administration of sulfanilamide in large daily doses (from 0.2 to 0.25 Gm) per kilogram of body weight.

GONCE, Madison, Wis [AM J DIS CHILD]

SEPTIC MENINGITIS. REPORT OF CASE. G L M SCHOLEFIELD, New Zealand M J 37 35 (Feb) 1938

The patient, a man 24 years old, was thrown from a motorcycle on March 29, 1937. He was unconscious for a few minutes and then went home. He remained away from work for one week, during which time frontal headache developed. Physical examination and roentgenograms showed no abnormality, and he signed a release from the hospital after eight days, only to return on April 13 with severe headache, pain in the neck and behind the eyes, photophobia and fever.

Examination showed stiffness of the neck and Kernig's sign on both sides. Lumbar puncture revealed opalescent spinal fluid. The cell count was 1,050 (mostly polymorphonuclears), the globulin test was markedly positive. Organisms were not seen on smear or culture. The right mastoid was opened and appeared normal, but in the roof of the antrum an old clot was found. The dura appeared thick. It was incised, and free pus was obtained from beneath the temporal lobe. This was drained, and thereafter the patient slowly recovered, being given neoprontosil

intramuscularly daily for eleven days and prontosil tablets (form not stated) by mouth. Cultures of the spinal fluid were negative throughout. No mention was made of culture of material from the abscess.

MULHERIN, Augusta, Ga [AM J DIS CHILD]

INTRACRANIAL COMPLICATIONS OF EAR DISEASE J P STEWART, Practitioner
141 603 (Nov) 1938

Suppuration occurring in the cleft of the middle ear may give rise to crippling disabilities, such as severe deafness, but it is only when suppuration extends beyond these boundaries that there is danger to life. The intracranial complications which follow acute and chronic suppuration are considered jointly, but there are certain distinctions. In acute infections the complications tend to be diffuse, and in chronic cases more circumscribed, in their initial stages. Thus in chronic cases initial circumscribed meningitis and delayed generalized meningitis and sinus thrombosis occur. Better results from treatment in the chronic cases might therefore be expected, and they do, in fact, occur.

This excellent article should be read in full.

GELSTON, San Francisco [AM J DIS CHILD]

THE DEAF CHILD P FRANKLIN, Practitioner **141** 615 (Nov) 1938

A most interesting part of this article is that relating to mechanical aids to teaching the deaf.

Noises and speech sounds are communicated to the child by two types of electrical amplifiers: (1) electroacoustic, (2) electrovibratory. The electroacoustic apparatus is used to apply stimulation to the natural auditory channel. It is designed to produce sound through a microphone, either from the human voice or from gramophone records. Ear phones are applied to the ears. The electrovibratory apparatus is used to transmit vibrations to the finger tips. These rest on a delicately vibrating metal plate or vibrating cork. By analogy the finger tip serves as the ear and the vibrating plate or cork as the ear phones.

The children are divided into two groups: (1) those who have some remnant of auditory perception, (2) those who have no auditory perception and are therefore trained to receive the impression of sound or human speech through a substitute sense—touch, or the vibrotactile sense. In either group the child is encouraged to watch the teacher of speech form words. His attention is drawn to the appropriate toy, picture or letter spoken. In this way education is assisted as it would be in a normal child.

With reference to the sensory mechanism for feeling vibration, several writers have suggested an analogy between touch and hearing. Touch has been described as primitive hearing which in the course of evolution has been taken over by a specialized organ—the ear—for appreciating vibrations of a limited range—the human range of hearing. Experience with the speech training of deaf-mute children by touch supports the idea of a fundamental relation between the two senses. The use of touch is not new. For centuries deaf-mute children have been placing their fingers on the teacher's larynx to feel the vibrations of vocal sounds.

Emphasis is placed on preschool training, which at first is carried out individually and later in small groups.

GELSTON, San Francisco [AM J DIS CHILD]

TUBERCULOUS OTITIS MEDIA R B LUMSDEN, Tr Med-Chir Soc Edinburgh,
1938, p 193, in Edinburgh M J, October 1938

The clinician presented a boy who had entirely recovered from an extensive radical mastoidectomy for tuberculous disease of the middle ear and gave the opinion that such otitis media is not rare, as he had observed several cases of it.

When a child suffers from an aural discharge that is resistant to treatment, tuberculosis should be thought of, and on repeated examination of the discharge tubercle bacilli may be found NERF, Kansas City, Mo [AM J DIS CHILD]

TREATMENT OF PURULENT STREPTOCOCCIC MENINGITIS BY SULFANILAMIDE
R MARTIN and A DELAUNAY, Ann med-chir 3 86 (March) 1938

Purulent meningitis caused by organisms of the streptococcus group is relatively rare, and the cases constitute only about 6 per cent of all cases of meningitis. In most of the cases the disease is secondary to infectious processes in the ears or nose. The mortality varies from 97 to 100 per cent. Recently, the use of sulfanilamide has been followed by recovery in cases of meningitis of this type. Large doses, up to 0.5 Gm every two hours, have been given, followed by gradual diminution of the dose to 4 and then to 3 Gm daily. In infants a dose of 0.001 Gm per kilogram of body weight has been used. In certain cases intraspinal administration is advisable, the authors advocate the use of from 10 to 20 cc of an 0.8 per cent solution daily, accompanied by drainage of the cerebrospinal fluid. In all cases in which the meningitis is secondary to a localized infectious process, there should also be surgical intervention.

DE JONG, Ann Arbor, Mich [ARCH NEUROL & PSYCHIAT]

OTOLOGIC RELATIONS TO DYSENTERY IN INFANCY B GALCSIK, Orvosi hetil
82 128 (Feb 5) 1938

In every case of dysentery an otoscopic examination was made, and if mastoidal empyema was suspected an operation was immediately made, with the infant under local anesthesia. This antrotomy was made even in cases in which the otoscopic examination did not show pathologic changes. In few cases was a healthy antrum found. Up to the years 1930-1932 these operations were rarely performed, and the mortality was 42 to 45 per cent. From 1933 on, when this operation became the rule, the mortality fell to 22 per cent. Galcsik thinks that in this great improvement, apart from the progress in internal treatment, intensive otologic treatment plays a great role.

GOTTCHÉ, Budapest, Hungary [AM J DIS CHILD]

Pharynx

PERIESOPHAGEAL ABSCESSES. THE IMPORTANCE OF EARLY SURGICAL INTER-
FERENCE WESTLEY M HUNT, Ann Otol, Rhin & Laryng 48 128 (March)
1938

The author reports cases and discusses infection of the mediastinum in the cervical region following rupture of the esophagus. He believes that this condition occurred many times prior to the advent of roentgenography and bronchoscopy and not being recognized was diagnosed as pneumonia or cancer.

Rupture of the esophagus may be caused by (1) foreign bodies, through immediate perforation, slow erosion or perforation on removal, (2) instrumentation, (3) spontaneous rupture with malignant growths.

Periesophageal abscesses in the cervical region are easily observed, and the surgical approach is easy. First confined to the area between the esophagus and the prevertebral fascia or the esophagus and the trachea, they may descend later.

The diagnosis is made by (1) the suspected or observed perforation, (2) marked collapse of the patient at the time of perforation, (3) pain, tenderness and swelling, (4) inability to swallow, (5) absence of dyspnea unless pneumothorax has occurred, (6) increased leukocytic count—up to 23,000, (7) sudden rise of temperature, (8) roentgen evidence of widening of the prevertebral or post-tracheal space, and (9) emphysema.

Hunt reports Lore's finding that fluid between the esophagus and the trachea tends to point in front of the carotid sheath and anterior to the sternocleidomastoid muscle. Fluid in the prevertebral space tends to point behind the carotid sheath and posterior to the sternocleidomastoid muscle. Lore pointed out also that anterior infections first show tenderness anterior to the sternocleidomastoid muscle and posterior infections posterior to it.

The incision for anterior approach is along the median border of the sternocleidomastoid muscle at the level of the sixth cervical vertebra. The incision is carried downward, the muscles and the carotid sheath are retracted, the middle thyroid vein and the inferior thyroid artery ligated and the thyroid gland retracted. The abscess is opened by blunt dissection, with frequent use of suction. Drains are inserted. The approach on the right side is easier and safer, as the dome of the pleura is lower, the esophagus being in contact with the pleura only in the middle. The thoracic duct is avoided on the right also. Care should be taken to pack off the fascial spaces down to the vertebral column in an effort to prevent a downward spread of infection. If the infection has already passed below, a drainage tube is carefully inserted behind the esophagus to this area.

In the posterior approach the incision is behind the sternocleidomastoid muscle opposite the abscess, and the abscess is approached by blunt dissection behind the carotid sheath. The only structure to avoid here is the cervical ganglion, which is attached to the prevertebral fascia. The brachial plexus is avoided by keeping above the omohyoid muscle.

The following conclusions are reached: 1. A feeding tube should be placed in the esophagus in any case of known or suspected rupture. 2. Daily roentgen examination should be done. 3. Any rise in temperature or white blood cell count, pain or roentgen evidence calls for immediate incision and drainage. 4. Intra-esophageal treatment should be used only in most carefully selected cases. 5. It may be better surgical technic to open and pack off any esophageal rupture before abscess has developed.

Twenty cases were analyzed and a number reported. In 16 of the 20 the patient was operated on, with 12 recoveries and 4 deaths. In 4 treatment was through the esophagus. The 4 deaths were in cases in which external drainage had not been established.

M. V. MILLER, Philadelphia

FOREIGN BODY IN THE UPPER ESOPHAGUS FOR FIVE MONTHS. M. C. MYERSON, New York State J. Med. **38** 885 (June 1) 1938.

A white girl aged 6 years complained of severe pain in the region of the upper part of the spine posteriorly. About five months previously she suffered from pain and discomfort in the throat. At that time she visited several dispensaries, without relief. Because of the localized symptoms, a roentgen study was made, a jackstone was found lodged in the upper part of the esophagus. The tracheo-esophageal wall was markedly swollen, and it was necessary to insert a flexible tube into the trachea before an esophagoscopy examination could be made. The foreign body was removed successfully, and the child made a good recovery.

Pain and discomfort in the throat of a child should suggest the presence of a foreign body. The same is true of pain in the region of the spine.

AIKMAN, Rochester, N. Y. [AM. J. DIS. CHILD.]

MASSIVE COLLAPSE OF LUNG FOLLOWING TONSILLECTOMY. RECOVERY. R. W. B. ELLIS, Proc. Roy. Soc. Med. **31** 772 (May) 1938.

A girl aged 9 years had suffered from asthma between the ages of 3 and 8 years. In December 1936 she had an attack of follicular tonsillitis and subsequently complained several times of sore throat. In April 1937 she was admitted to the hospital for tonsillectomy, on examination mucopus was found under the left middle turbinate and a roentgenogram showed well marked root shadows only. Tonsillectomy was performed and iodized poppyseed oil injected into the maxillary antrums. The operation was apparently uneventful, and bleeding was not excessive.

On the next day, the temperature rose, and the child appeared acutely ill. Movement of the right side of the chest was diminished. There was dullness on percussion. The breath sounds were almost completely absent over the right lung. These signs continued unchanged for three days, when the general condition improved. Roentgen study showed massive collapse of the right lung, with displacement of the heart and mediastinum to the right. Roentgen examination repeated a few days later showed expansion of the upper and the middle lobe and still a few days later reexpansion of the whole of the right lung, with the heart in the normal position. The patient was discharged from the hospital well and free from any abnormal physical signs.

WILLIAMSON, New Orleans [AM J Dis CHILD]

TUBERCULOSIS OF THE HARD PALATE M LANGLOIS, Bull Soc de pediat de Paris
35 690 (Dec) 1937

A lesion developed on the hard palate of an infant 2 months old. The left cervical glands were enlarged. The patient was admitted to the hospital at the age of 4 months. A biopsy of tissue from the hard palate was made and tuberculosis diagnosed. Later, in pus aspirated from a cervical gland, tubercle bacilli were demonstrated. The tuberculin test was positive. No mention is made of a roentgenogram of the chest. The infant died of tuberculous meningitis following pertussis at the age of 10 months. No contact with any person with open tuberculosis was established. The infant had been fed unpasteurized, unboiled milk from tuberculous cows.

BENJAMIN, Montreal, Canada [AM J Dis CHILD]

DEMONSTRATION OF PNEUMOCOCCI IN THE THROATS OF NORMAL INFANTS AND OF INFANTS WITH PNEUMONIA OR INFECTION OF THE UPPER RESPIRATORY TRACT
S NARASAKI, Acta pædiat japon 44 1036 (July) 1938

Pneumococci were found in the throats of 92 per cent (summer) and 26 per cent (winter) of all normal infants. In infants suffering from grip the frequency was 16 per cent, in those with bronchitis, 29.2 per cent and in those with pneumonia, 43.3 per cent. These observations prove that with the progress of the disease the frequency of positive cultures increases. The majority of diplococci belonged to type IV. Pneumococci were found in the throats of infants under 1 year of age as frequently as in the throats of older children.

KATO, Chicago [AM J Dis CHILD]

Larynx

LARYNGEAL DIPHTHERIA P BAYER, South African M J 13 47 (Jan 28) 1939

Bayer reports on a study of 1,291 patients with diphtheria admitted to the Fever Hospital, Johannesburg, South Africa, from 1930 to 1937. Of these 242 had laryngeal diphtheria and 124 required tracheotomy. The incidence of diphtheria in Johannesburg is less than 100 cases per hundred thousand of population, whereas that in Great Britain is 140 to 160 per hundred thousand. Diphtheria is almost unknown in children under 6 months of age and uncommon in those under 1 year. Its frequency then increases rapidly, reaching a maximum in children between the ages of 1 and 2 years. Thereafter it declines slowly and in children beyond the age of 8 becomes distinctly rare. The majority of patients have a temperature of 101 to 102 F, higher temperatures are uncommon. In at least 25 per cent of cases of faucial diphtheria a positive diagnosis can be made immediately from direct examination of a smear. In about 85 per cent of cases of faucial diphtheria culture of swab material is positive after twenty-four hours, and in 95 per cent it is positive after forty-eight hours. In regard to laryngeal diphtheria, however, after tracheotomy cultures from swab material taken from membrane found at operation or from the trachea itself are positive in only 60 per cent of cases. When

the patient was not tracheotomized, swab material gave positive cultures in only 50 per cent of cases. Faucial diphtheria occurs in over half the patients with laryngeal diphtheria and is an additional help in diagnosis. The results of tracheotomy in Johannesburg, with a mortality of 33 per cent, are good in comparison with those of tracheotomy elsewhere but not as good as those of intubation. Whether tracheotomy or intubation is done, the mortality is exceptionally high in children under 2 years of age. Although in very young children intubation gives better results, in older children tracheotomy gives slightly superior results. To a patient with acute streptococcic laryngitis, tracheotomy usually does not bring that intense relief from dyspnea that it gives to a patient with diphtheria. The prognosis in cases of diphtheria must be guarded. Of 41 deaths, 21 were due to spread of the diphtheritic process into the trachea and lungs, 13 to cardiac failure from shock and toxemia and 5 to bronchopneumonia. The complication of bronchopneumonia is by no means always fatal, of 13 patients only 5 died. The first essential in treatment is to regard laryngeal obstruction in a child as diphtheritic until it is proved otherwise. With faucial involvement a large dose of antitoxin, as much as 50,000 units, should be given. Experience is the best aid in deciding whether to perform a tracheotomy and when. Tracheotomy performed after intubation carries a frightful mortality. The author prefers low tracheotomy.

GONCE, Madison, Wis [AM J DIS CHILD]

CONGENITAL LARYNGEAL STRIDOR. D. N. NICHOLSON, Tr Med-Chir Soc Edinburgh, 1938, p 191, in Edinburgh M J, October 1938

Nicholson presented an infant of 6 months with congenital laryngeal stridor, a usually harmless type of noisy inspiration, which alarms the parent. The stridor is at its maximum at about the sixth month of life, having become louder as the child got stronger. It slowly wanes, to disappear by the end of the second year. The child is not disturbed by the stridulous condition. Congenital webbing and papilloma must be ruled out in the diagnosis.

NEFF, Kansas City, Mo [AM J DIS CHILD]

CLINICAL, ANATOMOPATHOLOGIC AND BACTERIOLOGIC STUDY OF TWO CASES OF ACUTE STENOSING LARYNGOTRACHEOBRONCHITIS, CHEVALIER JACKSON TYPE. P. ROHMER and C. OBERLING, Bull Soc de pédiat de Paris 36 242 (April) 1938

Two girls, 6 years and 11 months old, respectively, died of acute suffocative tracheobronchitis. Necropsy confirmed the diagnosis. Abundant mucofibrinopurulent exudate completely obstructed the air passages in many places. In the older child the trachea and bronchi showed the most involvement, while in the younger one the small and medium-sized bronchioles were affected, and there were a few scattered areas of bronchopneumonia. In the latter case cultures made from the interior of the lung gave growths of *Staphylococcus albus*, *Streptococcus haemolyticus*, Friedlander's bacillus and a gram-negative bacillus of the colon group which did not ferment maltose. Experiments with the strain of Friedlander's bacillus which was isolated showed it to be virulent for mice.

BENJAMIN, Montreal, Canada [AM J DIS CHILD]

Nose

NASAL SEPTUM SURGERY IN CHILDREN. M. H. COTTLE, Illinois M J 75 161 (Feb) 1939

After a discussion of the histologic aspects, causes, symptoms and treatment of deviations of the nasal septum, Cottle concludes that frequently nasal obstruction

and chronic discharge are the result of septal deviation, that often nonsurgical treatment is needed and is adequate, that occasionally surgical measures are indicated and that the type of operation which is appropriate to an adult is unnecessarily radical for a child in all but the rare instances of extreme deformity

BARBOUR, Peoria, Ill [AM J DIS CHILD]

SINUSITIS IN CHILDREN E C MITCHELL, J A M A **112** 207 (Jan 21) 1939

Sinusitis in children presents a favorable outlook for recovery and development of the sinuses if the condition is cared for early. Early recognition of the etiologic nature is important, especially if this is allergic. The treatment varies with the stage of the disease, it is outlined for the acute, subacute and chronic stages. The condition should be followed by roentgen examinations and observations for foci of infection.

HEERSMA, Kalamazoo, Mich [AM J DIS CHILD]

PARANASAL SINUSES IN CHILDREN A BOWEN-DAVIES, Proc Roy Soc Med **31** 1411 (Oct) 1938

Bowen-Davies made a routine examination of 55 children between the ages of 5 and 14 years. A roentgenogram was taken, the nose was cocaineized and swabbed, and both antrums were punctured. The washings were cultured and the antrums filled with iodized poppyseed oil, 40 per cent. Further roentgenograms were taken at once and at intervals of a week or so until the antrums were clear of iodized oil. The volume of iodized oil and the time it took to disappear were recorded. Organisms were found in the antrums of 23 patients and mucopus in the nose of 19. Cultures of the mucopus from 6 of these proved to be sterile. The organisms found in the antrums, both those in which the mucopus was infected and those in which it was sterile, were similar to those present in the nose. Five tables are given, listing the organisms found in the various cases, together with a series of roentgenograms showing the progress of the evacuation of the iodized oil. In all cases improvement followed the injection of iodized oil, not only in the clinical condition of the patient but also in the roentgenographic appearance of the antrums. Local treatment is of established value, and the removal of tonsils and adenoids may be advisable. An abundance of fresh air and an adequate diet, with a plentiful supply of vitamins may do a great deal to prevent sinusitis in children.

WILLIAMSON, New Orleans [AM J DIS CHILD]

A CASE OF ACUTE FRONTAL SINUSITIS TERMINATING IN DEATH STATISTICAL STUDIES SOJI SHIMIZU, Oto-rhino-laryng **12** 18 (Jan) 1939

In a 19 year old barber purulent sinusitis on the right followed a cold. A week later edema developed over the right side of the forehead and the right upper eyelid, the patient had a headache and a septic temperature. In ten days he was hospitalized with a diagnosis of frontal sinusitis on the right. With the patient under local anesthesia a classic incision was made for opening of the frontal sinus. About 30 cc of thick pus was evacuated from the subcutaneous tissue, but the abscess did not have an apparent connection with the frontal sinus. Closer examination revealed that the periosteum was lacking over the right orbital rim. The anterior plate of the frontal bone did not show any marked change other than acute congestion and a suggestion of slight softening. The mucous membrane of the sinus was hyperemic, particularly over the area where the periosteum was lacking. The cavity contained a large amount of thick, brownish pus. The frontal nasal duct was patent. The operation ended with evertion of the anterior ethmoid cells. The exciting organisms were *Streptococcus haemolyticus* and *Diplococcus pneumoniae*. The septic temperature continued after the operation, and the patient died on the ninth postoperative day, of bronchopneumonia.

The writer reviewed 47 cases of frontal sinusitis, acute and chronic, in the Japanese literature. The incidence among males was .69 per cent, the condition being more common among the young and middle aged and occurring more frequently on the left than on the right. In most cases there was acute exacerbation of a chronic condition. The acute condition was complicated by subcutaneous abscess of the forehead and orbital abscess, the chronic, by subcutaneous abscess and optic neuritis. Bony fistula of the frontal sinus occurred in the anterior or posterior table in 3 cases, in the superior wall of the orbit in 2 and in the ethmoid plate in 6. The mortality was 85 per cent.

HARA, Los Angeles

Miscellaneous

INTRAVENOUS INJECTION OF HYPOTONIC SALT SOLUTION CONTAINING SULFANILAMIDE FOR STREPTOCOCCIC MENINGITIS G M RETAN, *Am J Dis Child* 56 483 (Sept) 1938

In experiments on monkeys, planned to determine whether giving sulfanilamide intravenously has the advantage of increasing the concentration of the drug in the cerebrospinal fluid, Retan observed that when physiologic solution of sodium chloride containing sulfanilamide is given to monkeys intravenously the concentrations of sulfanilamide are greater in the blood than in the cerebrospinal fluid. When a hypotonic solution of sodium chloride containing sulfanilamide is injected intravenously, the concentrations during the first injection are the same as with the physiologic solution. However, if the injection of a hypotonic solution is repeated on the second day there occurs a shift to a higher percentage of sulfanilamide in the cerebrospinal fluid than is contained in the blood. A similar shift to a higher concentration in the cerebrospinal fluid than in the blood can be produced by giving the drug by mouth in solution or in capsules prior to the intravenous injection of a hypotonic solution of sodium chloride. The shift depends on the presence of sulfanilamide in the tissues of the body and the intravenous introduction of a hypotonic solution of sodium chloride containing sulfanilamide. The author is not in a position to know what result he would have obtained in his case of hemolytic streptococcic meningitis had he given sulfanilamide by mouth and by subcutaneous injection without using injections of hypotonic solution of sodium chloride containing sulfanilamide. There was prompt subjective and objective improvement within an hour after the beginning of each intravenous injection. The doses of sulfanilamide used in the intravenous solution (from 6 to 10 Gm in twenty-four hours) were unnecessarily large. An alkaline powder, of calcium carbonate and sodium bicarbonate, was given at intervals of four hours. The rate of injection most successfully used is 10 cc of solution each hour per pound of body weight. A 0.375 per cent solution has been found to be most effective. Treatment for five hours with several hours of rest between treatments is advised. Cerebrospinal fluid is released from the lumbar puncture needle during the intravenous injection for the purpose of relieving increased intracranial pressure. If the fluid is under considerable pressure and is spurting from the needle, it is wise to drain from 5 to 10 cc during half an hour. If the fluid is dripping rapidly, less than this amount should be drained. If the fluid emerges from the needle by a slow drop the stylet should be replaced at once without draining any fluid.

J A M A

DIPHTHERITIC INVOLVEMENT OF THE LIPS, WITH ABSENCE OF SIGNS IN THE NOSE AND THROAT H J LAVENDER and J B SQUIRES, *J A M A* 111 915 (Sept 3) 1938

A 10 year old Negro girl had a granular membranous lesion on the lower lip, which had developed twelve days after hospitalization for a severe burn. Cultures of material from the throat were negative until eleven days later. The history of

the case is given, the only one ever to have been reported in which diphtheria of the lip (and of the cheek, gums and alveoli as well) was present without the organisms being found in the throat

HEERSMA, Kalamazoo, Mich [AM J DIS CHILD]

PERSISTENT ANOSMIA FOLLOWING ZINC SULFATE NASAL SPRAYING F F TISDALL, A BROWN and R D DEFRIES, J Pediat **13** 60 (July) 1938

During the outbreak of poliomyelitis in Toronto in 1937 the zinc sulfate nasal spray for prophylaxis was used on a group of 4,713 children from 3 to 10 years of age. These children received two sprayings ten to twelve days apart, and 520 additional children of the same range of age received one spraying. The treatments were conducted in special clinics by otolaryngologists. Not more than 25 per cent of the children experienced temporary anosmia. Few, if any, reported subsequently to the various hospital clinics complaining of persistent anosmia.

Thirty-two otolaryngologists reported on the children treated by them in private practice. At the end of two months 36 children complained of anosmia, with or without disturbance of taste, and at the end of six months 52 reported anosmia. The complaint of persistent anosmia occurred more frequently among older children, only 5 under 10 years of age were reported as having anosmia at the end of two months and only 1 under that age at the end of six months. Persisting disturbance of taste and smell was noted in 11 patients who received only one spraying and in 39 to whom two sprayings were given. Of the 52 persons who had disturbances of smell and taste, some suffered marked loss of smell and in others smell was returning. Some complained of unpleasant odors and others of a distorted sense of smell. The persistence of a disturbance in smell and taste after a period of six months is difficult to explain on the basis of persistence of inflammation of the olfactory mucous membrane causing mechanical blocking of the olfactory area. The effect of a 1 per cent solution of zinc sulfate on the mucous membrane of the human being should be carefully studied to determine whether persisting disturbance of smell and taste may be due to injury of the olfactory area.

RAUH, Cincinnati [AM J DIS CHILD]

SULFANILAMIDE IN THE TREATMENT OF ACUTE INFECTIONS OF THE CENTRAL NERVOUS SYSTEM J B NEAL, E APPELBAUM and H W JACKSON, M Clin North America **22** 1419 (Sept) 1938

The value of sulfanilamide in the treatment of virus diseases is problematic. Also, its value in the treatment of meningitis due to the staphylococcus, the influenza bacillus or the nonhemolytic streptococcus is doubtful. The pneumococcus likewise seems resistant to sulfanilamide since, of 25 persons with pneumococcal meningitis in whom it was employed, only 4 recovered. While the experience of the authors with sulfanilamide in the treatment of meningococcal meningitis has been limited and the fatality high, they believe that it has a favorable effect on the disease and may well replace intravenous use of serum in cases of meningococcemia with or without meningitis. Most encouraging results were obtained in the treatment of meningitis due to infection with the hemolytic streptococcus. Earlier, during more than twenty-six years, the authors observed 274 cases of the various forms of streptococcal meningitis, recovery occurred in only 15 cases, 9 of which were definitely cases of infection with the hemolytic type of streptococcus. Since 1937 they have treated 19 patients with sulfanilamide, with 14 recoveries and 5 deaths.

The preparations used were neoprontosil given intramuscularly, sulfanilamide given orally and at times an 0.8 per cent solution of sulfanilamide crystals given intraspinally. As a rule, 5 cc or less of neoprontosil was given to younger children and 10 cc every four hours to older children and adults. In addition, from 5 to 15 grains (0.3 to 1.0 Gm) of sulfanilamide was given by mouth every six hours. This combination seems to be more effective than either preparation alone.

The advantage of giving the drug intraspinally is open to question. The large doses advocated by some do not seem to be necessary. The authors emphasize that in the treatment of meningitis caused by the hemolytic streptococcus it is of great importance to remove the primary foci of infection.

EUGENE H. SMITH, Ogden, Utah [AM J DIS CHILD]

TREATMENT OF PNEUMOCOCCIC MENINGITIS M. FINLAND, J. W. BROWN and A. E. RAUH, New England J Med **218** 1033 (June 23) 1938

Of 99 patients with pneumococcic meningitis, none recovered except 6 of the 10 who were treated with sulfanilamide alone or with serum. The procedure adopted was as follows: 1. Complete and frequent drainage of the spinal fluid was carried out. 2. Continuous large doses of sulfanilamide were given by mouth or by subcutaneous injection, if necessary, immediately. The optimal dose has not been determined. Sodium bicarbonate was given with each dose. 3. The pneumococcus was identified as rapidly as possible, and sufficient specific antipneumococcus serum was given intravenously to establish a balance of antibody in the circulating blood. 4. Moderate intake of fluid was maintained. 5. About two hours after a reasonable dose was given, blood was withdrawn, and the serum was separated. 6. At the time of the next lumbar puncture this serum was given intraspinally (from 5 to 10 cc). 7. Lumbar punctures were repeated until the fluid was normal. The frequency was determined by the initial pressure of the fluid and its cellular and protein contents. 8. After the first week of sulfanilamide therapy, if anemia developed transfusions were given and were repeated as necessary until the use of the drug was discontinued (after from seven to fourteen days, at which time the spinal fluid was sterile). Such procedures serve to insure a balance of antibody in the blood stream and to control the bacteremia. They should, in most instances in which the sulfanilamide effectively reduces the infection, provide an adequate amount of antibody and complement in optimal proportions and in a medium which is likely to give the least local or general reaction and the greatest antibacterial effect.

J. A. M. A.

VERTIGO: ITS NEUROLOGICAL, OTOLOGICAL, CIRCULATORY, AND SURGICAL ASPECTS W. RUSSELL BRAIN, Brit M J **2** 605 (Sept 17) 1938

Brain points out that vertigo may arise as a result of disturbances of function at various levels of the nervous system. His classification includes (1) psychogenic vertigo, (2) vertigo due to cortical disturbances, (3) vertigo of ocular origin, (4) vertigo of cerebellar origin, (5) vertigo due to lesions of the brain stem, (6) vertigo due to lesions of the eighth nerve and (7) aural vertigo. An analysis of 41 cases indicates that the average age of onset is 49 years. Brain believes that focal sepsis is the most important etiologic factor. Most patients respond well to some form of medical treatment, but surgical division of the vestibular fibers of the eighth nerve occasionally is necessary.

ECHOLS, New Orleans [ARCH NEUROL & PSYCHIAT]

A SIMPLE METHOD OF BRONCHOGRAPHY FOR CHILDREN N. M. JACOBY and G. KEATS, Lancet **2** 191 (July 23) 1938

If iodized poppyseed oil 40 per cent is introduced into the pharynx of a child under general anesthesia it must enter the trachea. In 34 cases this principle has been applied to bronchographic study, the children being anesthetized with avertin with amylene hydrate and ether and the oil injected into the pharynx through the mouth with a syringe and cannula. The method has been found to be satisfactory and free from danger.

The child is given a course of postural drainage for several days before bronchographic study is attempted. The only thing to be guarded against at the time of bronchographic examination is the collection of iodized oil between the

cheek and gums, but this will not happen if the point of the cannula is kept close to the posterior pharyngeal wall. The amount of iodized oil to be used varies with the size of the child, but the authors have never used less than 3 or more than 8 cc for each side.

The child is kept in the semisitting position for about half a minute after the injection, he is then laid down on his back, his side or his face, depending on which lobe it is desired to fill. In many cases he is laid consecutively in all positions. An interval of two to three minutes must be allowed to elapse between injection of the iodized oil and the taking of roentgenograms.

The induction of general anesthesia in children who already have pulmonary lesions may appear to be contraindicated, but the authors believe that this objection is more theoretic than actual. On rare occasions general anesthesia is contraindicated.

LANGMANN, New York [AM J DIS CHILD]

PURULENT MENINGITIS CURED BY SULFANILAMIDE. DISCUSSION ON THE NATURE AND POSSIBLE RELAPSE OF STREPTOCOCCIC MENINGITIS. R. MARTIN and A. DELAUNAY, Bull. Soc. de pédiat. de Paris **36** 107 (Feb) 1938.

A boy 8½ years old had streptococcic meningitis, from which he recovered after oral administration of sulfanilamide. Seven months after the onset of this disease purulent meningitis developed a second time, associated with rhinopharyngitis. No bacteria were demonstrated in smears or cultures of the spinal fluid during this recurrence of meningitis, but it is believed that the infection which was shown to be responsible the first time remained latent and later flared up, causing a recurrence of meningitis. The patient was again given sulfanilamide by mouth and again recovered.

BLNJAMIN, Montreal, Canada [AM J DIS CHILD]

OCULAR SYMPTOMS IN EPIPHARYNGEAL TUMORS. REPORT OF CASES. E. CUSTODIS, Klin. Monatsbl. f. Augenh. **101** 49 (July) 1938.

In an introduction Custodis explains the importance of tumors of the epipharynx by the proximity of this organ to the base of the skull and the sphenoid bone. The observation of 4 cases prompts him to draw the following conclusions. Benign as well as malignant tumors of the epipharynx may produce disturbances of the sensory, motor and sympathetic nerve fibers connected with the eye. While the malignant neoplasms of the epipharynx may be characterized by a certain complex of symptoms, the benign tumors manifest themselves in various clinical forms. Unexplained disturbances of the eyes and of the nerves supplying the orbit should prompt an examination of the epipharynx by the rhinologist. Roentgenographic examination may facilitate the diagnosis. The characteristic changes produced by a tumor of the epipharynx can be recognized in the axial view of the base of the skull and on anteroposterior exposure of the skull.

K. L. STOLL [ARCH. OPHTH.]

Society Transactions

MONTREAL MEDICO-CHIRURGICAL SOCIETY, SECTION OF OTOLARYNGOLOGY

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April 14, 1939

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NASAL SINUSITIS AND ASTHMA A THESIS Presented by DR FRANCIS M RACKEMANN, and DR FRANCIS L WEILLE,† Boston

In a recent paper on "Intrinsic Asthma," one of us (Rackemann, F M Intrinsic Asthma, *J Allergy*, to be published) presented the reasons for thinking that asthma might have a cause different from allergy. Certainly there are cases in which it is quite impossible to show a cause which is allergic in the ordinary sense. Whereas allergy is often an adequate explanation of asthma, there is reason to think that it is only one of several causes which can precipitate the asthmatic syndrome.

The relation of the nose and throat to asthma is important for two principal reasons. 1 Lesions of the sinuses and polypi in the nose are so common as almost to be expected in cases in which asthma has become severe. 2 In the presence of a lesion, it is always tempting to both physician and surgeon to advise radical operative treatment, in spite of abundant evidence that results are not often good. Let us review the knowledge of this subject briefly.

There are three ways in which disease of the paranasal sinuses can theoretically cause asthma. First, chronic inflammation can give rise to an exudate which drips down the back of the throat to cause a chronic irritation of the trachea and larger bronchi. Second, inflammation of the sinuses can cause irritation of the nerves in the nose, from which impulses can pass by reflex pathways through the sphenopalatine ganglion to produce overactivity of the parasympathetic (vagus) system and so cause bronchospasm by increased muscular and glandular excitability. Third, chronic sinusal infection can act as a focus of infection from which bacteria and products of their metabolism may enter the lymphatics and the blood stream to set up sensitization and subsequent allergic responses in the bronchial structures.

In case any one of these theories was good, one would expect that treatment of the sinusal infection would bring relief to the asthma, and one must admit that in some cases surgical intervention does good. In any large series of cases, however, particularly when the patients are followed for as long as two years after the operation, the end results are often disappointing. The reasons for failure are numerous. First, whether the operation is conservative or radical, it is next to impossible to remove all of the septic process. The focus persists. Moreover, even if removed at first, it may recur. Second, radical treatment may change the structure of the nose so much as to impair its normal function seriously. It is conceivable that scar tissue can in itself lead to irritation of nerve endings and so promote asthma by reflex mechanisms. Third, postoperative care is almost as important as the operation, for without it healing is slow, discharge from the sinuses continues and the postnasal drip continues to cause trouble. Finally, the failure of sinusal operation may well depend on the thesis, first mentioned in 1929

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by Rackemann and Tobey, that disease of the sinuses in asthma is a part of the picture and not a cause of it. The object of this paper is to present further evidence to support this thesis.

Incidence—In 1929 F. M. Rackemann and H. G. Tobey (*Studies in Asthma IV The Nose and Throat in Asthma, Arch Otolaryng* 9 612 [June] 1929) reviewed 1,074 cases of asthma in which the patients had been followed carefully for two years and found evidence of sinusitis in 271 cases, or 25 per cent. In 1932 R. A. Cooke (*Infective Asthma Indications of Its Allergic Nature, Am J M Sc* 183 309, 1932) commented on the variation of sinusal disease with the age of the patient. Sinusal disease was found in 38 per cent of young persons, whose asthma began between the ages of 10 years and 30, but when the onset was later, between 30 and 50, the incidence was raised to 65 per cent. When it was after 50, sinusal disease was found in 85 per cent. W. T. Vaughan (*Some Rhinologic Aspects of Allergy, J Allergy* 4 127, 1933) studied 132 cases which included instances of asthma of all kinds and affecting patients of all ages. Thirty per cent of the patients had had previous operations without benefit, and at the time of study 94, or 71 per cent, presented evidence of nasal disease. S. F. Kelly's (*Incidence of Sinusitis and Nasal Polypi in Bronchial Asthma, Laryngoscope* 46 692, 1936) figures are a little higher, for of his 100 patients 89 had hyperplastic involvement of the sinuses and only 11 were free of trouble. In a clinic specially planned for nasal studies in asthma, F. L. Weille (*Studies in Asthma XIX The Nose and Throat in Five Hundred Cases of Asthma, New England J Med* 215 235, 1936) in 1936 found that 70 per cent of 500 patients with asthma of all ages had sinusitis.

S. S. Bullen (*Incidence of Asthma in Four Hundred Cases of Chronic Sinusitis, J Allergy* 4 402, 1933) approached the problem from the opposite direction. He tried to find how many patients with sinusal disease had asthma in addition. He studied 400 patients with definite sinusitis and found that only one quarter had evidence of any pulmonary disease and that only an eighth (12.2 per cent of the whole) had asthma. The point was made that in only 8 per cent did the asthma begin at the same time as the sinusitis. One can say, therefore, that in asthma sinusal disease is common but that in sinusal disease asthma is only one of numerous complications. To have asthma without sinusal disease is unusual, but to have sinusal disease without asthma is common.

Pathologic Picture—The pathologic picture of nasal sinusitis has been described, and the literature has been reviewed in great detail, in the book by F. K. Hansel (*Allergy of the Nose and Paranasal Sinuses*, St. Louis, C. V. Mosby Company, 1936) and more recently in an excellent article by H. Semenov (*The Surgical Pathology of Nasal Sinusitis, J A M A* 111 2189 [Dec 10] 1938).

There are two principal varieties of sinusal disease. One depends obviously on an infection of the mucous membrane and is associated with pus. The cells of the exudate are mostly neutrophilic polymorphonuclears, and bacteria are easily cultured. This is the common form which, according to H. Semenov (*The Surgical Pathology of Nasal Sinusitis, J A M A* 111 2189 [Dec 10] 1938), occurs in 50 per cent of cases. Nonpurulent sinusitis, sometimes called hyperplastic or polypoid, may result from a purulent process, or it may depend on some other mechanism, not clearly understood but recognized as concerned with allergy. In all cases, trouble begins with edema of the mucous membrane. This may depend on impairment of circulation, perhaps small thromboses in the capillary walls, it may depend on abnormal capillary leakage, or it may depend on obstruction to the normal lymphatic drainage. Once started, edema results in degeneration of the epithelium and of the basement membrane under it. In purulent sinusitis the edema becomes infiltrated with polymorphonuclear leukocytes, whereas in hyperplastic or allergic sinusitis eosinophils and eosinophilic plasma cells are widely distributed and become a characteristic part of the picture. In cases of acute involvement the whole process may subside without harm, but in other cases connective tissue infiltrates the swollen areas, cysts of various kinds are formed, and, more characteristic, a state of chronic hyperplasia, referred to as thickened mem-

brane in the roentgenologic report, takes its place. As the surface of the membrane forms crypts and pockets, it becomes irregular and polypoid as a part of the degenerative and later of the reparative process. Thickened membrane may harbor pockets of pus within itself, as shown originally by F. L. Weille (*Asthma* XI The Pathology of Allergic Tissue as Seen in the Nose and in the Accessory Sinuses, *Arch Otolaryng* **12**:785 [Dec.] 1930) and later by R. C. Grove and R. A. Cooke (Etiology and Nature of Chronic Hyperplastic Sinusitis, *Arch Otolaryng* **18** 622 [Nov.] 1933). Weille found that these pockets occurred in about 10 per cent of cases. Cultures of material from the sinuses were studied by Grove and Cooke. They cultured the washings of the sinuses and compared them with other cultures made from the lining membranes themselves. In 60 per cent of the cases the same organism was found in both specimens, but in the others the organisms were different. In about a third of the cases cultures from the membranes were sterile. They stated the belief that polypoid depended on the infectious element in the process. Semenov (The Surgical Pathology of Nasal Sinusitis, *J. A. M. A.* **111** 2189 [Dec. 10] 1938) stated the belief that in two thirds of the cases hyperplastic sinusitis without evidence of gross infection is due to allergy. It is easy to understand that anatomic obstructions like deviations of the septum interfere with proper aeration and drainage and so aggravate all the processes, including edema, inflammation and degeneration.

Nasal polypoid are quite as important as the sinusal infection and more characteristic of asthma. T. E. Walsh and J. R. Lindsey (Cytology of Nasal Polypoid, *Arch Otolaryng* **20** 649 [Nov.] 1934) described two types. In those few which result from obvious infections, the cells in the polypoid are neutrophils, and removal does good. In the more common variety associated with allergy, the tissue is full of eosinophils, and removal helps for a time only.

Polypoid have been studied carefully by R. A. Kern and H. P. Schenck (Importance of Allergy in Etiology and Treatment of Nasal Mucous Polyps, *J. A. M. A.* **103** 1293 [Oct. 27] 1934). In an important paper, they pointed to the discrepancy between their common occurrence in conditions of purely extrinsic origin and their rarity in the ordinary infectious processes. In asthma the incidence of polypoid is high (30.5 per cent). In hay fever and chronic vasomotor rhinitis it is lower (13 and 14 per cent, respectively), and in nonallergic diseases, especially in ordinary sinusal infections, the finding of polypoid is unusual. These figures, they said, lead to the conclusion that polypoid are of allergic origin.

The results of operation on sinusal lesions throw a little light on the nature of these processes. In 1933, F. L. Weille (Studies in Asthma XVIII The Surgical Treatment of Chronic Sinusitis in Asthma, *J. A. M. A.* **100** 241 [Jan. 28] 1933) made a careful study of 40 patients with asthma on whom he had operated for chronic sinusal involvement. Five of them were cured of their asthma, and 9 were markedly improved, 6 were moderately improved, but the other 20 were not affected. Moreover, even of the patients for whom good results were obtained, when they were followed a little longer time, several had relapsed—the asthma had recurred. On the other hand, the sinusal disease itself was often benefited, and after operation the lesions became easier to control. Paradoxical were two interesting observations. Of 3 patients having severe asthma and bilateral pansinusitis, operation on one side only resulted in marked improvement of the asthma in 2 and moderate improvement in the third. Second, a number of patients studied later seemed to have an excellent condition in the nose, with all evidence of disease in the sinuses cleared away, but in spite of this their asthma continued quite as before.

In 1935 R. A. Cooke and R. C. Grove (Relation of Asthma to Sinusitis with Special Reference to the Results from Surgical Treatment, *Arch. Int. Med.* **56** 779 [Oct.] 1935) reported on 120 cases, in 70 per cent of which good results were obtained surgically. They emphasized the importance of complete operation, which produced a good result in 86 per cent, as contrasted with a good result in only 39 per cent of the cases in which surgical treatment was incomplete. Weille's later (1936) figures (Weille, F. L. Studies in Asthma XIX The Nose and

Throat in Five Hundred Cases of Asthma, *New England J Med* 215 235, 1936) are much less favorable. His series comprises 485 patients. Of these, 290 (60 per cent) had no operation. A few had tonsillectomies, and others had extraction of bad teeth. What interests us is the 100 patients for whom operation was done on one or more of the sinuses. Seventeen of these 100 had extrinsic asthma, and so far as the asthma was concerned operation produced a "cure" in 3 cases and improvement in 8 others. Eighty-three of the patients had intrinsic asthma, and in these the end results for the asthma included 7 "cures" and 47 patients improved. In 29 patients, however, the asthma was unchanged, and in some cases it was worse after operation than before. Some of the paradoxical results mentioned by Weille in an earlier paper deserve further consideration and will be mentioned presently.

More recently N. Fox and J. W. Hained (Treatment of Asthmatic Patients in Otolaryngologic Practice, *Arch Otolaryng* 25 393 [April] 1937) have rendered an interesting analysis of patients, with rather startling results. In a group of 150 patients whose sinuses required operation, improvement occurred in from 32 to 60 per cent, according to the operation performed, intranasal extirpation of the ethmoid sinuses being much less effective than total extirpation of all the sinuses at the same time. However, in a similar group of 150 patients who were treated by "medical means," many methods being used the results were poor in every case. The total duration of the follow-up was not stated.

Thesis—The thesis proposed here is that asthma, nasal sinusitis with nasal polypi, blood eosinophilia and the peculiar debility called "allergic toxemia" are all parts of a syndrome which depends fundamentally on some "X factor" as yet unknown. Allergy, which has been studied so extensively, is only one of many exciting factors which may precipitate symptoms in the presence of the "X factor." Other excitants are much more simple. They include head colds, fatigue, emotional strain and even changes in weather and temperature.

This conception has developed from a study of the cases of intrinsic asthma (Rackemann, F. M. Intrinsic Asthma, *J Allergy*, to be published) in which, by the circumstantial evidence provided by the history and the daily progress of the patient, the influence of foreign substances, both in dusts and in foods, can be excluded. The patients were divided into groups according to their clinical histories. In a few, the asthma had changed its character from isolated attacks of extrinsic origin, each dependent on exposure to a particular foreign substance, to a chronic persistent disease. In others, the asthma had from the first borne a close relation to colds in the head, which occurred in some only two or three times a year but in others every few weeks, especially in winter. In a third group, which included more men than women, the asthma had begun suddenly, usually after the age of 45.

Finally, a group of particular interest was that in which asthma, usually of a severe type, developed rather suddenly in persons, mostly women, who had suffered for some years with chronic persistent vasomotor rhinitis. The table in the paper is summarized here. The figures in this table deserve comment. First, almost half of the total number had a positive family history of allergy, and something over a quarter had positive cutaneous reactions to one substance or another. How can these two items be correlated with the diagnosis of intrinsic asthma? The factor of inheritance is not incompatible with the thesis, for our hypothetical "X factor" may well be something which is inherited. The reference of R. A. Kern and H. P. Schenck (Importance of Allergy in Etiology and Treatment of Nasal Mucous Polyps, *J A M A* 100 241 [Jan 28] 1933) to polypi in allergy applies equally well to polypi in asthma. The many positive cutaneous tests are excluded for the reason that the particular substances reacting could not be shown to be concerned with the patients' symptoms. We find that many positive cutaneous reactions occur even in normal persons without symptoms to go with them.

The right half of the table is more interesting. Thirty per cent of the patients had had previous operations on the nose and throat, obviously without benefit.

Furthermore, 45 per cent, or almost half, showed lesions in the nose and sinuses at the time of examination. These figures have varied somewhat in the different groups.

About half of those included under "Asthma after colds" had had only two or three colds a year, the term "asthmatic bronchitis" was applicable. The disease was not severe, and, as expected, only about one third had had or showed any trouble with their sinuses. In none of this subgroup was true pansinusitis observed. Two of the patients had had polypi removed in the past, and 1 had polypi at the time of examination. About one fifth of the patients had had previous operations on the nose and throat—submucous resections, polypectomy, and excision of an antral cyst—but nothing more radical than these procedures, and it is important to note that in none of the cases did these previous operations afford any benefit so far as preventing further attacks or modifying the course was concerned. In the other half of the group, in which colds were more frequent and the asthma more severe, lesions of the nose and sinuses occurred in 39 of the 69 patients. About two thirds of the lesions consisted of pansinusitis, with the other third being merely thickened membrane in the sinuses. Previous operations had been done on about half of the patients who had lesions, most of them being simple polypectomy, but 4 radical sinusal exenterations had been done, without benefit.

Intrinsic Asthma

	Num ber of Cases	Num ber of Males	Aver- age Age at Onset	Family His- tory of Allergy	Cuta- neous Tests Show- ing Allergy	Previous Opera- tion on the Nose and Sinuses	Present Lesions in the Nose and Sinuses	Death from Asthma
Extrinsic asthma changing to intrinsic	16	7	50	10	10	4	4	3
Asthma after colds	135	52	31	55	36	32	50	3
Sudden onset	83	45	50	27	22	16	40	4
Vasomotor rhinitis developing into asthma	49	11	37	21	10	34	35	10
Total	283	115	39	113	78	86=30%	129=46%	20

When asthma begins suddenly at about the age of 50, one hardly expects a large number of previous operations, but if sinusal lesions are a part of the picture, one might expect many of them. They were found in almost half the cases. Thickened membranes in the sinuses and definite polypoid pansinusitis, often with retained secretion, were the two diagnoses, made in about equal numbers of cases. Most of the patients in both categories had polypi in the nose, and many polypi had been removed in the past, without benefit. Radical operations were done on 5 of these patients. Typical is the experience of a patient who was free of asthma for about six weeks after the operation and then had asthma again as badly as before. A year later he died in a typical attack of asthma, and autopsy showed his bronchi plugged with tenacious, inspissated material causing death by suffocation.

There were 4 deaths in this group. Two of them were those of patients in whom the nose and sinuses were apparently clear of gross lesions. One, already mentioned, had thickened membrane in both antriums, the fourth had true polypoid sinusitis, operation for which had been considered but was postponed when the attack became so much more severe.

In 2 patients the onset of severe asthma was attributed to an operation on the nose and throat, 1, a woman of 55 with chronic sinusal trouble, first began to have asthma after polypi were removed, the other was a man of 52 with frequent colds and chronic sinusitis who dated his asthma from the time of a sinusal operation. Both patients are still in trouble.

Finally, the group which is of particular interest comprises those who give a history of vasomotor rhinitis for several months before the onset of their asthma. Out of the total of 49 patients, 10 died of asthma. Permission for autopsy on 7 of them was obtained, and 4 showed typical bronchial plugs. The group includes about 17 per cent of all the cases of intrinsic asthma. Three fourths of the group were women, in whom the nasal symptoms began in their twenties and the asthma in their thirties. About 75 per cent of the patients had had previous operations on the nose or sinuses and, nevertheless, still had sinusal lesions. On the other hand, a few remained clear of sinusitis, and it is important that even in spite of this freedom several died. One cannot say that the nasal lesion was the reason for the fatal outcome. In 3 cases, there was a history of bilateral radical antral operations done several years ago, and yet the asthma had continued, in 1 case to death from asthma at the age of 49. Cutaneous tests in the group were consistently negative, and many of the patients were admitted to the hospital ward without change in their symptoms. Thirty-one of the patients had both previous nasal operations and also present lesions in the nose and sinuses. Seven young women had had chronic nasal discharge, frequent obstruction and sneezing for many years—in 2 cases since childhood—when asthma began suddenly between the ages of 22 and 29. Three of the 7 women have died. There were 11 men and their stories were similar. The stuffy nose and frequent colds in the head had begun in the early twenties and then had led to asthma, which had continued persistently and increased steadily but surely in its severity despite all manner of treatment. Two of these men have died.

One was a young physician of 34 in whom a profuse watery nasal discharge with persistent obstruction developed, followed in two months by asthma, which continued intermittently for 10 years until his death at the age of 44. He had had two attacks of bronchopneumonia, each followed by temporary improvement in his asthma, and he had had two extensive radical operations on his antrums and ethmoid sinuses, likewise with temporary improvement but with no permanent gain. On several occasions, he had been admitted to the hospital when frequent doses of epinephrine were no longer able to control his asthma. He would vomit and fall into a virtual collapse. Twice, however, a sudden improvement in his asthma occurred without obvious cause, and the violent paroxysms ended by themselves as if by crisis. The last attack began like the others and progressed until he suffocated. Autopsy showed the lungs markedly distended and with the characteristic sticky plugs filling all the bronchi.

The other man had been troubled with symptoms referable to the sinuses for some months, and then, after an operation on his antrums asthma suddenly developed for the first time at the age of 30. From that time, asthma continued throughout all seasons, despite various admissions to the hospital, for thirteen years, until his death in a violent attack at the age of 43. He also was sensitive to acetylsalicylic acid. His treatment was always difficult and always unsatisfactory, although every known remedy was tried. His sinuses were excised, local treatments to the nose were given, bronchoscopic procedures were performed, his teeth had been extracted, and, finally, the thoracic chain of sympathetic ganglions was removed from his left side, with the development of a typical Horner syndrome but with no change in his symptoms. He died in the hospital ward, where he had been for several weeks, the last attack beginning in the same way as many other attacks. Autopsy showed the classic picture of distended emphysematous lungs, the cut section of which showed tough, tenacious plugs, which actually protruded above the cut surface.

There were 16 older women, each of whom presented a long history of chronic vasomotor rhinitis before the onset of asthma. Two of them died of asthma, although each had had several extensive operations on her sinuses. This group, with asthma after vasomotor rhinitis, is impressive, if only because 10 of the 49 patients have died. Whatever may be the relation between the earlier vasomotor symptoms and the later asthma, it is clear that operative removal of the sinusal contents, including the membranes, had had no important effect on the

process as a whole Many sinusal operations have been done without change in the symptoms

What to Do for Sinusitis in Asthma—This report of our observations concerns a series of particularly difficult conditions, and it is all too evident that in them relief of asthma is unusual to say the least However, if asthma of all kinds is taken together, improvement from surgical intervention occurs in at least half of the patients so treated, and this improvement may continue for weeks or months

As pointed out by one of us (Weille, F L *Studies in Asthma* XVIII The Surgical Treatment of Chronic Sinusitis in Asthma, *J A M A* **100** 241 [Jan 28] 1933), the degree of improvement in the nose—the elimination of polypi, the removal of septal spurs and the control of sinusal drainage—is not necessarily related to the degree of improvement in the asthma Whereas the asthma may be relieved for months or years, it must be noted that the chances are nearly nine out of ten that sooner or later the wheeze will recur These facts fit in well and provide strong support for the thesis that sinusitis is a part of the asthmatic syndrome and not a cause of it

Nevertheless, the disease in the upper respiratory tract can be reached and need not be neglected A chronic postnasal discharge is a common cause of tracheo-bronchitis, it can make a bad matter worse, and if local treatment can modify it the patient should have the benefit of that local treatment

As the rhinologist should be able to recognize allergy, so the allergist should be able to examine the nose He can see the color and character of the nasal mucous membrane, he can note whether the septum is obstructive, he can recognize polypi, and he can examine the sinuses by transillumination In short, he can obtain without much difficulty a rough idea of any nasal lesion which may be present, and so he can decide about the need for rhinologic consultation

It is said that nasal disease should be treated on its own merits and without regard to the asthma This is often true, but whenever "medical" and "allergic" treatment do not bring satisfactory results for the asthma within a reasonable time, the possibility of trouble in the nose should be considered before the asthma has advanced to a secondarily infected process demanding operation as a last resort

What can the rhinologist do? His chief aim must be to relieve the postnasal discharge He must prevent reflex disturbances from polypi, and he must consider focal infections Meantime and most important, he must take great pains to disturb the normal structure and function of the nose as little as possible

Shrinkage and suction, repeated at frequent intervals, with proper use of sprays between treatments, may accomplish much In asthma the exudate often seen in the posterior pharyngeal wall has a dense, tenacious, sticky structure, comparable to that of the plugs seen in the bronchi at autopsy Good control of the asthmatic paroxysm may sometimes result from its removal

In many cases, it has been found that if local treatment to the nose can be continued systematically for a time, great symptomatic improvement of both the nose and the asthma may result Recurrence of symptoms may be postponed until the true nature of the asthma can be found Perhaps an extrinsic cause (dust) can be removed or some disturbance outside the respiratory tract can be treated so that the general condition of the patient can be built up enough to control the entire syndrome

In other words, even if the nasal lesion is only part of the picture and even if local treatment to the nose will modify only a part of the patient's trouble, this modification may remove enough of the burden to allow a general improvement to occur

SUMMARY

From a review of the literature as well as from personal observation of cases, the following findings are stated

1 About a third of the new patients who apply for treatment of asthma have already had operations on the nose and/or sinuses, and about half have lesions at the time of examination

2 The pathologic picture of the nasal lesions in asthma is characteristic and is similar to that of the lungs in asthma

3 The results of further nasal operations leave much to be desired

The thesis is proposed that asthma is only part of a syndrome which includes lesions of the nasal sinuses with formation of polypi and eosinophilia both in the lesions and in the blood stream and which depends fundamentally on an α factor so far unknown. Allergy is only one of the many exciting factors which in the presence of the α factor can precipitate symptoms

If the nature of the nasal lesion indicates operation for itself without regard to the asthma, operative treatment will do good, but the good will be only partial and only temporary in most cases because the nasal lesion is a part of the picture and not a cause of it

However, conservative local treatment may be worth while

DISCUSSION

DR W J McNALLY It is important for all otolaryngologists to realize the close association between allergic sensitivity and some diseases of the nose and throat, which Dr Rackemann and Dr Weille have stressed

I fear that many of them are not fully aware of the work of Kern and Schenck, which strongly suggests that mucous nasal polypi are as much an indication of allergic sensitivity as is asthma or hay fever. Because of this association it is impossible to cure the patient by local nasal treatment unless the specific allergic irritant is determined and controlled. This is especially true of the more chronic nasal polyposis and sinusitis associated with bronchitis and asthma. The focus of infection in the sinuses can be eradicated completely only by an external operative approach to all the sinuses. Such a complete operation, however, is of little value unless the allergist is able to detect and control the allergic factors—the original cause of the whole cycle of the disease

In addition to the closest cooperation between the allergist and the otolaryngologist, abundant patience and persistence are necessary to clarify this involved problem

DR J S L BROWNE I have been asked to discuss briefly the relation of histamine to allergy and anaphylaxis. I should like to associate Drs S Karady and B Rose with these remarks. Manwaring was one of the first to suggest that anaphylactic shock is associated with a liberation of histamine in the dog. Code recently demonstrated clearly a marked increase in histamine in the plasma during anaphylactic shock in this species. The difficulty that histamine fails to cause the change in blood coagulation seen in this species has recently been obviated by the demonstration that heparin is liberated from the liver. Histamine liberated in the case of the guinea pig has been shown by Bartosch, Feldberg and Hagel to come from the lung itself. Karady showed that pretreatment with histamine would prevent anaphylactic shock in the guinea pig, and this has been confirmed by Smith. Karady and I have recently shown that histaminase given intravenously ten minutes before the shocking dose of antigen prevents anaphylactic shock in the guinea pig. Karady, Selye and Browne showed that mild nonspecific damage given twenty-four hours before the shocking dose ameliorates or prevents anaphylactic shock. In the case of allergic states, such as asthma, the effects of histamine pretreatment and histaminase have not as yet been clearcut, some authors claiming good effects and others failing to obtain them. One difficulty in using histaminase is that it is unstable and does not keep well except in tightly sealed ampules or capsules. Rose has recently demonstrated the release of histamine into the circulation after stimulation of the skin in cases of dermatographism and has also shown the importance of the adrenal cortex in the destruction of histamine. Roth and Horton showed that in sensitivity to cold histamine is liberated and that histaminase cures the condition. In connection with so-called physical allergy, Karady has recently advanced a new explanation. He has demonstrated that exposure of guinea pig serum or of the hindlegs of the guinea pigs to cold or heat produces changes in

the animals' own proteins which cause them to become antigenic, the substances thus produced he calls "auto-antigens" These scattered remarks may help to show the possible significance of the metabolism of histamine in allergic conditions

DR DAVID H BALION I was impressed with the series of cases which Dr Rackemann and Dr Weille showed

A few years ago I treated the condition in a series of cases with bronchoscopic procedure As is known, bronchoscopic work on asthma has been done for about forty years The early bronchoscopists injected cocaine and epinephrine, and it was evident that some of the excellent results obtained were due not only to these injections but also to the passing of the bronchoscope and the aspiration of the secretion Some patients have associated bronchiectasis, others have a tenacious gluey secretion, so that in selected cases bronchoscopic procedure should be considered an aid

As far back as 1925, I gave injections of iodized poppyseed oil to a number of asthmatic patients for diagnostic purposes, but in this procedure one must be extremely cautious Only a small quantity of the oil should be used

DR H E MACDERMOT Dr Rackemann and Dr Weille ventured into theoretic considerations this afternoon May I ask them to embark on speculation and suggest what in their minds will be the description of the x factor?

The presence of an x factor in these strikingly severe conditions, which give physicians such hard work and such distress, is definitely to be reckoned with In trying to handle such patients one comes continually to ask, "What can it be that is carrying on this chronic condition?"

DR A T HENDERSON Dr Rackemann said that he was not going to say anything revolutionary or anything that was going to settle the whole question once and for all I was rather relieved to hear him say that, because one is much more apt to take the things he said as understatement rather than overstatement For a great many years Dr Rackemann has stood for sanity and stability on the matters under discussion

I want to congratulate the Section on Otolaryngology on their choice of Dr Rackemann, and I feel that he has given all his hearers something sound and worth while

The question ever arises of when to operate and when not to operate in such cases—how much to do and how much to leave undone

One is likely to deal with antritis and hope that the patient will be better, perhaps forgetting for the moment that the ethmoid or other sinuses may be involved or that the lower respiratory tract may be the seat of infection

A few cases have been observed here in which the ending has been fatal in which the same bronchial mucous plugs have been found One case I recall, that of a woman who went into a status asthmaticus She had an intrinsic type, which is difficult to deal with She became unconscious and deeply cyanosed after a hypodermic injection of morphine While she was still in coma, a roentgenogram of the chest was made, and it was observed that the diaphragm descended with inspiration and then recoiled violently into the chest She figuratively had a rope tied around her neck, and she died from asphyxia Even in the oxygen tent there was no relief

One condition of this kind was relieved by intratracheal administration of ether During the administration of the anesthetic, it was necessary to remove the catheter as the patient was not being anesthetized The end of the catheter was found completely plugged with tenacious bronchial secretion, which had to be pulled out, and then satisfactory anesthesia and relief were obtained Would bronchoscopic procedure in such cases be of value, or is the condition too critical to justify instrumentation?

DR FREDERICK SMITH I was asked by the committee to discuss what might be said about bacteria I did not hear mention of a single organism, so that there is not a great deal for me to say

I must confess that I am surprised that cultures of material from the sinuses are not made As far as micro-organisms are concerned, one of the striking things is the variation in any particular case between the results of the cultures

made at different times during the course of the condition. In such instances it is difficult to determine which, if any, bacteria can be responsible. Nevertheless, there are conditions which seem to be related to the presence of micro-organisms in the respiratory tract. I remember one woman whose sputum yielded cultures of streptococci, and each great spasm corresponded with an increase in the organisms present, and lesser attacks corresponded with a decrease. She did remarkably well with vaccine from that organism. Two years later she had a relapse, but with no organisms present which fulfilled the criteria of the previous occasions. Vaccines at this time failed to help her at all.

As everybody knows, every sort of organism may be found in the sinuses. It is surprising that infections with some micro-organisms seem to respond to therapy and with others seem to do so badly. For instance, there is a fair regularity with which pneumococcic sinusitis responds to specific therapy and a marked irregularity in the response of staphylococcic infection.

Again, as far as bacteria are concerned, everybody realizes their complexity of structure, and it becomes an important matter to insure that the sensitizing antigen is present in the vaccine injected.

In lesions of staphylococcic origin part of the lesion is allergic sensitization of the tissues, and not infrequently active immunization is preceded by desensitization. A person may have relief with the first doses of an attempted immunization and frequently fail to benefit from subsequent courses given for relapse. The same holds true for other bacteria, and it is of more than academic interest to speculate on the relation of desensitization and hyperimmunization in attempting (1) to remove the sensitivity of the tissue and (2) to eliminate the focus of infection by the administration of vaccines and toxoids.

It is difficult to assess the current opinion on the value of vaccine in chronic asthmatic conditions, but I take it that there is a greater belief in its efficacy in Montreal than in many other places in North America. It does seem a striking thing that the speaker today failed to make any mention of bacteria, and I rather feel that my own opinion coincides with that of Dr Rackemann on that point.

DR RACKEMANN. I think I have speculated enough already. I do not know any more about this than the hearers do. There is no advantage in speculating too much—especially in public! One thinks of various things without getting very far.

As for bronchoscopic procedure, I think that it is a good point. Perhaps one would do better to use the bronchoscope before the patients get into such a desperate condition. One hesitates to do a bronchoscopic procedure, and by the time one gets around to it, it is often too late. Perhaps it would be wise to use bronchoscopic procedures sooner. The patients are not in too poor condition, because they are young people and their hearts are in good condition.

As for bacteria, I agree with Dr Smith that cultures taken from the same patient at different intervals do not always show the same infection. The technic seems to be important. Some years ago I studied two series of cases, in one of which autogenous vaccines had been used and in the other stock vaccine. In these two series the results were similar. They were good only when the vaccine produced a local reaction at the site of inoculation. When the dose of vaccine is too large, malaise, fever and an increase in asthma may occur. We believe that the effect of vaccines is nonspecific.

There are five criteria of allergy.

1 Characteristic pathologic picture (The symptoms of the patient must depend on this.)

2 Other manifestations of allergy (e. g., eczema, hives)

3 Family history (If a man's son has eczema that is a sign supporting the diagnosis of allergy in the father.)

4 Positive cutaneous tests

5 Eosinophilia

Finally, as regards the taking of a history, I should stress the importance of using dates and accounting for all the time.

Book Reviews

Otolaryngology in General Practice By Lyman G Richards, M D, Fellow in Surgery, Courses for Graduates, and Assistant in Surgery, Harvard Medical School, Associate Professor of Otolaryngology, Tufts Medical School, Research Associate in Otolaryngology, Children's Hospital, and Otolaryngological Surgeon, Peter Bent Brigham Hospital, Boston, with a foreword by D Harold Walker, M D, Professor Emeritus of Otology, Harvard Medical School, Past President, American Otological Society, and Former Chief and Present Consultant in Otology, Massachusetts Eye and Ear Infirmary, Boston Price, \$6 Pp 352, illustrated New York The Macmillan Company, 1939

The author, a distinguished otolaryngologist with a background of the finest traditions of this specialty, presents a textbook for the general practitioner His chief aim has been to detail the essentials of otolaryngology in such a manner as to enable any practicing physician to gain the proper insight to handle a case intelligently and to seek help at once where his skill and talents may be limited

This is not an easy task, especially when one recalls that about 20 per cent of general practice deals with diseases of the upper respiratory tract and that the advances in otolaryngology have been great in recent years

The author has admirably succeeded in his purpose He has compressed in 352 pages an enormous amount of information for the busy man who must have precise data for quick reference, in a literary style that makes for easy and interesting reading, omitting the more complicated anatomic, physiologic and pathologic discussions from the graduate student's point of view, avoiding as far as possible devoting too great space to the consideration of rare conditions, instead describing adequately the more common diseases of the ear, nose and throat by instruction in history taking, methods of examination and interpretation to the end that a definite conclusion is soon reached as to where the lesion may be and what therapy is indicated The practitioner is guided carefully as to whether the method of treatment may be within his province or should be referred to the specialist

This book should be in the hands of every general practitioner for frequent reference and review It could be used with profit by medical students for collateral reading, by graduate students and by residents Though the book may be somewhat terse and elementary for the specialist, the message of the author, because of his sound reasoning, wide teaching and clinical experience and surgical skill, merits the attention of his colleagues

Medical Climatology Climatic and Weather Influences in Health and Disease By Clarence A Mills, Ph D, M D, Professor of Experimental Medicine, University of Cincinnati Price, \$4.50 Pp 296 Springfield, Ill Charles C Thomas, Publisher

The author stresses the importance of climatic environment to the basic physiologic reactions of the body, the combustion rate, energy level, rate of growth and development, resistance to infection and many other vital characteristics He has assembled the facts from the knowledge thus gained, drawing freely from the researches of eminent workers, as well as his own first class contributions, into a volume of 296 pages

The arrangement of the text and subject matter, the illustrations, type and format are excellent Many diseased states are considered in the causation or perpetuation of which climatic environment may play a part Some advice is given, in a number of the discussions, that should aid not a little toward the attainment of better results

Colonization for climatically handicapped persons and the conditioning of indoor environments are detailed in separate chapters. The index is complete and informative.

Though some comments are made on keeping the extremities warm and comfortable during sudden climatic changes, it is hoped that the author will, in the next edition, enter more fully into the details of proper clothing to be worn during the varying seasonal changes in order to lessen the likelihood of chilling or overheating of the body. It is accepted by otolaryngologists the world over that climatic changes often excite or contribute to infections of the upper part of the respiratory tract.

This book is recommended to otolaryngologists interested in the relation of fluctuations of climate and weather to the upper respiratory tract, to research workers and, as a reference book, to physicians.

Eye, Ear, Nose and Throat Manual for Nurses By Roy M. Parkinson, M.D., F.A.C.S., Head Oculist and Aurist to St. Joseph's Hospital, San Francisco. Fourth edition. Price, \$2.25. Pp. 243, with 79 illustrations. St. Louis: The C. V. Mosby Company, 1939.

This is a textbook for nurses, prepared after a careful study of the needs for such a book and written in such a manner that it can be used to great advantage in teaching student nurses the things most important for them to know in order to carry out intelligently the specialist's orders and give the best possible care to their patients. The text is divided and outlined according to subject matter, so that it may readily be used for reference work as well as for general study. The language is not too technical, and those technical terms which it is necessary for the nurse to know are clearly explained. The illustrations, mostly done by the author and his wife, are excellent and help to clarify the descriptions of the anatomy and physiology of the parts dealt with and also to render the various operative setups and treatments easily visualized. Care is taken not to be too specific about details of treatment which may vary according to the individual preferences of specialists in each hospital, but the principles of treatment are emphasized so that students may understand the need for careful nursing care and the best ways to carry it out. One chapter deals with public health nursing and problems often met in the specialties concerned, and the information given therein can be useful to graduate nurses in all fields of work. Altogether, this book should be a valuable part of a nurse's library, whether used in class or merely to supplement her lectures.

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